



RESEARCHES

17

INTO

THE PATHOLOGY AND TREATMENT

OF THE

ASIATIC OR ALGIDE
CHOLERA.

CHURCHILL,
COLL. REC.
MED. EDN.

BY

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TO

JOHN FORBES, ESQ., M.D. F.R.S.,

FELLOW OF THE ROYAL COLLEGE OF PHYSICIANS; PHYSICIAN IN ORDINARY
TO HER MAJESTY'S HOUSEHOLD; PHYSICIAN EXTRAORDINARY TO
H.R.H. PRINCE ALBERT, &c. &c.

MY DEAR SIR,

When the probable spread of Cholera towards this country, led me to believe that the publication of this little work would prove useful, I immediately determined to request your permission to dedicate it to you. It is a source of great gratification to me, that you have complied with this request, and have permitted me to Honor this Treatise, by placing on this page the name of one who has done so much for

medical science as yourself, and who is most justly esteemed a great and philosophical physician.

I am anxious to take this opportunity of expressing to you my deep sense of obligation for the considerate kindness and disinterested friendship with which you have honored me.

Believe me to be,

My dear Sir,

Your obedient servant,

E. A. PARKES.

3, Upper Seymour Street, Portman Square,

Nov. 1st, 1847.

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ON THE
PATHOLOGY AND TREATMENT
OF
CHOLERA.

CHAPTER I.

INTRODUCTORY REMARKS.

EVERY one must feel the strongest interest in the investigation of Cholera, the most fatal disease known in the annals of medicine, but no one more so than the military surgeon, who not only has seen this disease, uncontrolled by art, extend its ravages over some of the most beautiful regions of the earth, but who also bears indelibly imprinted on his memory those feelings of helplessness and despondency, engendered by his personal experience of the comparative impotence of his science, and the too frequent inefficacy of his aid. The literature of Cholera offers many examples of the labours of the military surgeons serving in India in this department of medicine; labours which have been generally conducted, under every possible disadvantage,

by men overwhelmed by duties, and taxed, as a general rule, beyond their strength, by the sudden incursions of this singular and fatal disease. It was to be expected, then, that those elaborate chemical processes and analyses, which are evidently necessary before the nature of Cholera can be determined, would be seldom carried out, from absolute want of time and of materials.

The following observations form no exception to this rule—I can contribute little or nothing to the chemical knowledge of the animal fluids in Cholera: I have attempted to investigate the disease merely from a minute observation of the symptoms during life, and of the changes discovered after death.

But it appears to be sufficiently obvious that organic chemistry can alone give us the requisite insight into the nature of Cholera. In this disease all the living processes are arrested in a greater or less degree; either primarily, as is the case with the great function of respiration, or secondarily, as appears to be the case with nutrition generally. In 1830-2, organic chemistry was perhaps hardly competent to deal with these profound inquiries, and to trace the first effects of the poison of Cholera on the blood of the pulmonary capillaries: at any rate, the analyses then made of the blood and the other animal fluids led to no certain conclusions, and the nature of the disease remained an unsolved problem.

But if, as appears probable, this mysterious pestilence is again about to pass over the face of Europe, it will be encountered by sciences immeasurably more efficient than at the period of its last attack. Whether organic

chemistry be yet sufficiently advanced fully to penetrate into the steps by which its morbid poison acts upon the blood, will possibly soon be determined. The value of the additions which the balance and the microscope will make to our knowledge of Cholera, will, perhaps, soon be evident to every one : I hope I am not too sanguine in believing that these additions will throw an unequivocal and undistorted light on the pathology of the disease.

In order, however, that chemistry may most beneficially act, a prior discussion seems to be necessary, for the purpose of indicating the proper method of inquiry. The value of the different symptoms, and their probable relations to each other, are subjects which require to be known beforehand, and the possible conditions of the blood, as connected with different sets of symptoms, should be previously determined.

It is for the purpose of commencing this discussion that I publish this short Inquiry into the Pathology and Treatment of Cholera : I profess nothing more than this. If in doing so I have preferred taking my own observations as a basis for discussion, rather than the observations contained in the many admirable works published on Cholera in Europe, or in India, I have, as I believe, good reasons for this preference : for, in the first place, a bare enumeration of the views of other writers is hardly needed while yet the late epidemic is fresh in the minds of the profession ; and secondly, opinions based upon personal experience and observation should be kept apart from the inferences which may be drawn from the investigations of others. It is to be

understood, therefore, that this treatise is not a history of Cholera, but simply an account of my individual knowledge of it. The substance of the treatise was written in India some years ago, from observations collected during two severe epidemic attacks in 1843 and 1845, and at the time that I was serving as Assistant-Surgeon in one of H. M. Regiments.

I am, however, convinced, by a careful study of almost all the works that have been published on Cholera, that I am by no means singular in my opinions on the pathology of the disease. On the contrary, there is hardly a statement in the following pages which could not be corroborated by several quotations from different writers; although the general bearing and tenor of the discussion are, I believe, original. I had at first intended to have subjoined a number of these quotations as corroborative evidence, but I found that this would swell a small treatise into a large book, and would besides have been directly opposed to the plan I had proposed.

It will be seen that the leading idea I have formed of the nature of Cholera is, not only that it is primarily a disease of the blood, as has been so generally surmised, but that the changes induced in the function of respiration, directly consequent on the alteration of the blood, are the proper and distinctive symptoms of the disease. The alterations of the pulmonary functions, therefore, enter into my definition of true Cholera, and, for the purpose of expressing this decisively, I have ventured to employ the term “*Algide Cholera*,” as a synonyme for the “*Cholera gravior*” of Orton and

others. The term “Algidus,” first employed, I believe, by Chomel, and since then by several French writers, seems to me to point very happily to the most remarkable symptom of the disease, viz., the diminution of animal heat. So remarkably does this symptom contrast with the increased temperature of many diseases, that I cannot but think the study of these two opposed classes will throw light on some of the most difficult problems connected with respiration.

It must not be supposed that although I have based my inquiry solely on the severest cases I witnessed, and chiefly on the fatal cases, that I have wished to draw any broad and defined lines between these, and those slighter and generally curable cases which are seen during the prevalence of an epidemic, or witnessed as sporadic cases during its intervals. I believe that an attentive observer may trace up every grade from the merest Cholerine to the terrible disease which kills inevitably in a few hours. The possibility of so doing, however, implies alliance, but not identity—the cases may pass into each other; the one may induce the other, but yet the changes in the blood may be different. To this subject I shall presently return; discussion on it in this place would be premature; I have introduced it here, merely for the purpose of guarding myself against the imputation of over-refinement of diagnosis, or of drawing abrupt lines of demarcation which have no existence in nature, between allied affections.

Whatever may be the conclusions of the profession, in respect of my hypothetical views of the nature of

Cholera, I believe that the facts contained in the following treatise will always be useful and interesting, as illustrating the type of the disease prevalent in India twenty five years after the commencement of the present epidemic. Taken in connection with the various papers on Cholera published during the last few years in the Calcutta and Bombay Transactions, and in the Madras Medical Journal, these facts form an appendix to the works of Jameson, Scott, Orton, Bell, Christie, Annesley, Twining, and others, in which the earlier periods of the epidemic have been so minutely and admirably recorded.

CHAPTER II.

POST-MORTEM APPEARANCES IN CASES OF CHOLERA.

THE summary of the post-mortem appearances is drawn from a comparison of 46 dissections in males : of these, 39 were of persons dying in what has been called the blue or collapsed stage, and 7 of persons dying of the subsequent febrile affections. Of the 39 cases, 23 were Europeans, and 16 were Asiatics ; and of these sixteen, 10 were Hindoos, and 6 Burmans. All these dissections were made with great care, and I believe that the general summary of facts may be confidently relied on. Four of the seven cases of consecutive fever were also made with great minuteness ; but as the number is so small, I have not ventured to draw any conclusions from them, but have simply detailed them at a subsequent page.

The average time after death at which the post-mortem examination was made in the case of the 39 individuals above referred to, was $7\frac{1}{2}$ hours. The longest period was 22 hours, and the shortest under an hour. In 25 cases the time was under 10 hours. I was anxious to make the dissections as soon as possible after death, in order to avoid confounding the effects of climate and a high thermometric range with the results of the disease.

The average age of the Europeans was 27 years ; of

the Asiatics, 38 years. The greatest age among the Europeans was 36, and the least 22 years; the greatest age among the Asiatics was 70, and the least 25 years.

In order to avoid as much as possible the use of the indefinite terms "congested" and "engorged," I was anxious to devise some mode of estimating the quantity of blood contained in the minute tissues of organs. The following rough plan was the only one I could devise that was sufficiently simple and easy of application:—I weighed each organ entire, on its removal from the body. I then made incisions through it, about half an inch apart from each other, and washed and drained it for a few minutes. I then weighed it again, and the loss of weight was taken as some index of the quantity of blood which had exuded.

In all cases the rigor mortis came on very soon after death; whether it lasted longer than usual I could not determine, as the bodies were buried in many cases before it had ceased. The bodies continued warm for a considerable time, and the peculiar heat of the trunk which comes on occasionally during the last moments of life seemed often to increase after death. Muscular twitchings and contractions were seen in most of the bodies opened within an hour after death, and lasted for 20 or 30 minutes: they were most common in the abdominal and pectoral muscles, and, after these, in the upper arms, thighs, and neck.

The skin often became lighter in colour after death, and the shrivelled appearance of the hands and feet diminished. There were no sudamina or petechiæ in any case.

HEAD.—The head was carefully examined in 21 Europeans and 13 Asiatics :—

	lbs. ozs.	drs. Av.
The greatest weight of the cerebrum among the Europeans was*	3 15	
The next greatest weight	3 4	
The smallest weight	2	
The greatestAsiatics	2 13	
The smallest	2	
The greatest weight of the cerebellum, pons and medulla oblongata, among the Europeans, was	7	
The smallest	3 4	
The greatest weight of the same parts among the Asiatics, was	7 1	
The smallest	3 5	

1. The skin of the scalp and face presented the dark hue common in cases of Cholera, although in a less degree than before death.
2. The external veins were well filled in three cases ;

* The weight of this cerebrum was enormous ; but I weighed it twice, and feel satisfied of the correctness of the observation. It is remarkable that the cerebellum of this individual was exceedingly small ; in fact, the same person furnishes the largest cerebrum and the smallest cerebellum, noted in the above Table. It may not be uninteresting to describe the individual whose cerebrum weighs equal with Cuvier's whole encephalon :—He was an Irishman, a soldier, 34 years of age ; of sanguine temperament, with light eyes and reddish hair : he was not distinguished during life for a particularly large head, and, speaking from memory,

they were very turgid in one; in another, twelve ounces of uncoagulable blood flowed out on section of the scalp.

3. The sinuses and veins of the dura mater were considerably congested in sixteen cases; they were moderately so in five: in the remaining thirteen cases there was no unnatural congestion. In two cases fibrine was deposited in the sinuses, with semi-coagulated dark blood; in one case the blood was dark and thick; in another, liquid and non-coagulable. In one it coagulated on exit from the sinus, contracted and expelled serum, and became reddened on the surface.

4. The veins of the pia mater were much congested in nine cases; they were moderately full in seven; in eighteen they were not particularly altered.

5. There was considerable effusion of serum into the

I think his head was what is commonly called badly formed; viz. large posteriorly, and contracted and shelving in front. He was a married man, and had two or three children, to whom he was much attached. At the time of his death he was suffering intense mental distress, on account of the death of one of his children, a day or two previously, from Cholera. He was a carpenter by trade, and earned a good deal of money by his work at the time he was off duty. He was a man of excellent character, but never, I believe, rose to the rank of a non-commissioned officer. This did not arise from inability, apparently, but from an indisposition to exert himself in that capacity. I knew him for three years before his death, and am not aware of any mental peculiarity. When attacked by Cholera he was remarkably anxious to recover, and retained this anxiety till a few moments before death. The brain was perfectly healthy.

arachnoid cavity in eight cases out of thirty-four. In several cases the meshes of the pia mater were distended with serum.

6. In one case there was considerable effusion of liquid blood in the same situation ; no rupture of vessels could be found.

7. The quantity of fluid which flowed out of the sheath of the spinal cord into the occipital cavities was between one and three ounces in twenty-one cases ; in one case it was four ounces ; in one, five and a half ; in one very considerable, but the quantity is not stated ; in three the quantity was small, that is, below one ounce ; in seven it was not sufficiently abundant to be measured. In several experiments the fluid did not coagulate when heated ; in one it coagulated slightly ; in one it became turbid, and deposited a flaky-looking substance, but did not coagulate. In two cases in which it was uncoagulable, it gave no precipitate with nitrate of silver.

8. The substance of the brain was rather soft in twelve cases ; in one case the right optic thalamus was slightly softened ; in one case the softness involved only the centre of the brain generally ; in two cases the brain was rather harder than natural ; in one unusually hard. In seventeen cases it was not altered from the natural state. In two cases of softening, it was doubtful how far the change was cadaveric ; in the remainder there was no suspicion of this.

9. In five cases the cerebral substance was manifestly oedematous. This occurred in the cases which presented the highest degree of softness.

10. In one case there were numerous red points on section ; in five cases these were over the average ; in twenty-eight cases not more than usual.

11. The lateral ventricles were quite empty in nineteen cases ; in nine they contained a few drops of fluid ; in three they contained one drachm in each ; in one, two drachms ; and in one, four drachms. In another case there was some fluid, but the quantity was not noted.

12. The choroid plexus was considerably injected in four cases ; it was slightly injected in four cases : in all the rest, unaltered.

13. The cerebellum was a little softer than usual, and its veins were injected in several of the cases in which the same conditions were observed in the cerebrum ; otherwise it presented no alteration.

14. In only two cases did there appear to have been antecedent disease of the brain, or its meninges. In one case this was very slight, consisting merely of old granular lymph on the superior surface of the hemispheres. In the other case, the veins of the pia mater, over the posterior surface of one hemisphere, were singularly enlarged, contorted, and varicose, and in the cerebral substance, immediately below the surface, a collection of these veins connected with the superficial veins, formed, by their interlacement, a small tumor about the size of a bean ; in which, and between the vessels, were deposited calcareous particles in considerable quantity.

15. *Summary.*—I conclude from this statement that the most usual appearances in the head, consist

in the accumulation of blood in the veins of the dura and pia mater, and in the effusion of serum or of blood consequent upon this. This congestion is sometimes as great in recent cases as in cases of consecutive fever with head symptoms. It is considerable in the most malignant cases, but I am unable to say whether the accumulation of blood, and the rapidity or malignancy of the case, bear to each other any determinate ratio.

The spinal cord was not examined in any case.

Larynx and Trachea.

In one case there was a collection of adhesive mucus in the laryngeal ventricles ; in several there was frothy mucus in the trachea, and slight redness in the same situation, general or confined to the bifurcation. In the majority of cases the parts were unaltered.

CHEST. *Lungs.*—The lungs were examined in 23 Europeans and 16 Asiatics :—

	ozs. drs.
The average weight of the right lung in 22 Europeans was	14 0
The left	12 6
Ditto, right lung 16 Asiatics	11 7
The left	11 0

The greatest weight of the right lung among the Europeans was 25 ozs., and the smallest weight 8 ozs.

The greatest weight of the left lung among the Europeans was 22 ozs., and the smallest, 6 ozs.

1. The average weight of the lungs appears from this statement to be lessened in Cholera. The extent

of the diminution, however, cannot be known in the case of the Asiatics, as the average weights of these organs in Hindoos has not yet been determined. The extent of the diminution in Europeans cannot either be fixed with certainty, as some observations of mine, drawn, however, from a small number of cases, seem to indicate that the lungs are always lessened in weight in the English residents in India. If, however, an European standard is taken, and the average weight of both lungs in adult males be considered to be 46 ozs. according to Dr. Clendinning, or 43 ozs. according to Dr. Reid, then the diminution in the case of both lungs in Cholera will be 17 or 20 ozs. The reason of this will immediately appear.

2. Old adhesions of the pleuræ existed in 14 cases out of 39.

3. In one case, each pleural sac contained a few ozs. of serum.

4. On cutting through the roots of the lungs a quantity of blood usually escaped from the divided vessels, and particularly from the pulmonary arteries. In one case, the quantity of this was two pints ; in one case, one pint ; in one, 24 ozs. ; in one, 8 ozs. ; in one, 6 ozs. ; in nine, between 2 and 5 ozs. ; in two cases the quantity was not measured, but is said to have been considerable ; in six cases there was "some" blood, but the quantity is not noted ; in three cases there were "several ozs. ;" in five cases there was a "small quantity ;" in two cases there were a "few drops ;" in two cases there was none at all ; and in the other five cases no note is made of the circumstance.

5. In 24 cases the condition of the blood is particularly noticed. In two cases it coagulated with tolerable firmness ; in five it formed a loose, dark, unshrinking coagulum ; in five it is described as semi-coagulated, that is to say, dark soft clots floating in a dark red serum ; in ten cases it was uncoagulable ; and in two cases it is simply stated to have been dark and tarry.

In the majority of instances its colour was dark, and in several cases became lighter on exposure to the air ; in one case it was light and nearly transparent at the moment of exit from the cut root.

6. Many writers have described great congestion of the lungs in cholera ; the observation seems to have reference chiefly to the quantity of blood escaping from the roots, as on section of the substance of the lung very little blood escapes as a general rule.

The quantity of blood in the substance of the lungs was considerable in 3 cases ; in 1 case there was extravasation of blood in the lower lobe of one lung ; in 6 cases there was a considerable quantity in the vessels of the lower lobes, but none in the upper ; in 10 cases the quantity was small ; in 11 cases there was no blood in the minute texture of the lungs. In 8 cases the point is not noted. Moreover, on incising, washing, and draining the lung, the loss of weight was only 3*ij.* 9*ij.* on an average of 13 cases.

7. Although there was often little blood in the pulmonary texture, there was sometimes a considerable quantity of frothy and perhaps bloody serum, which I am inclined to think is not altogether cadaveric, as

muco-crepitant and mucous râles are sometimes heard for some hours before death in the posterior part of the lungs. The quantity of frothy serum is noted to have been very great in one case ; considerable in 9 cases ; considerable in lower lobes only, or posteriorly, in 3 cases ; moderate in 8 cases ; very little in 11 cases, and in 7 cases there was no serum at all, or so small a quantity as to be neglected.

In these seven cases, which were the most malignant, there was little serum, and beyond what escaped from the roots, no blood in the lungs ; the lungs were generally pale anteriorly, becoming red on exposure to the air ; they were often in the state described by Annesley and Twining, as “a bruised, semi-hepatized, or fleshy appearance ;” they were considerably or in a great degree collapsed from the sternum and ribs, lying back upon the spine ; their weight was often singularly diminished, and when sliced and placed in water, they seemed like a sponge to absorb it and to acquire weight.

8. In 14 cases the lungs were completely collapsed, appearing in some cases almost like the lungs of a foetus. In 3 cases they were considerably, and in 8 cases they were slightly, collapsed ; and in the remaining 14 cases the collapse was in some cases altogether, and in other cases partially prevented by old adhesions. This collapsed condition sometimes was seen to be confined to one lobe, or to a part of a lobe, while the remainder of the lung was occupied by frothy serum.

9. Accompanying this appearance, in direct proportion to it, and in an inverse ratio to the amount of the

serum, was a singular deficiency of air in the tubes and cells, and a consequent partial or complete want of crepitation. In the fleshy bruised portions of the lung this non-crepitation was always well marked. Sometimes the upper surface was non-crepitant, while the lower, oedematous and engorged, was as crepitant as usual. In 24 cases the crepitation was totally abolished; in 15 cases it was notably diminished in some part of the lung, and in one of these cases abolished completely in the upper lobes. The want of air was not owing to mechanical impediment, as, on artificial respiration, air passed readily in, distended the before collapsed lung, and partially or wholly restored the crepitation. This I proved by many trials.

10. Another frequent appearance was a pitting on pressure; not apparently depending on the oedema, or being in proportion to this, but being most marked in the superior lobes, and on the upper surfaces. In 22 cases this pitting on pressure was well marked over the whole lung; in 3 cases it was present only in the upper lobes; in the remaining cases it was not present, or at any rate was not recorded. Accompanying this state was often a soft leathery or oily feel of the lungs. It is needless to state that neither of these appearances are peculiar to Cholera, but from their frequent occurrence in this disease, they demand notice.

11. I have already stated that the substance of the lungs appeared generally to be denser than usual, or, as some writers have termed it, "semi-hepatized." This appearance when it occurred was very distinctive: the lung was reddish, non-crepitant, apparently denser than

usual, and contained little blood or serum ; but it floated in water, was not granular, did not break down under the finger, and, in fact, its condition was very different from the stages or the results of pneumonia. In 19 cases out of 39, this state existed in a great degree, but it was more or less evident in all. In these 19 cases the lung is variously noted, as "dense and semi-hepatized," "carnified," "dense, like a slightly hardened spleen," "having a dense hard feel, and a fleshy appearance," "having a leathery feel," "feeling like washed leather," "having a dense feel, and dark, as if hepatized," "having a leathery oleaginous feel," "being liver-like or carnified," "having a red uniform appearance," or terms of a similar kind are used, but all applied to degrees of the same state. In several cases the lung seemed to present nearly the same appearance as in simple condensation from serous fluid in the pleura. In one case only it is noted that the lower lobes appeared softer and more friable than usual.

12. The colour of the lung, both on the surface and on section, varied considerably. In many cases it was dark on the surface, and paler on section ; in some it was dark throughout ; in the most collapsed cases it was generally pale, becoming red on exposure to the air. In 16 cases the colour is particularly noted as pale-red ; in one case it was black, as if the tissue were stained with blood ; in one case it was mottled with large black patches on a pale ground ; in the remaining cases it presented various shades of dark-red, varying in depth in different parts. The colour seemed to bear an exact ratio to the quantity of blood : it was darkest

in the cases in which there was the greatest quantity of blood in the minute structure, and palest where there was no blood or frothy serum.

The colour not only became redder on exposure to the air, but, on inflation, it became vividly red. In every instance in which this process was used, the pale lung became redder, and the dark lung lighter, in colour.

13. It has already been said, that, when the lung was in the most collapsed state, it seemed in some cases to gain weight when placed in water. In 9 cases this increase of weight was carefully noted: the lungs were weighed, then incised and drained, and placed in water. In spite of the quantity of fluid expressed, the increase of weight in 4 cases was 4 oz.; in 1 case $3\frac{1}{2}$ oz.; in 1 case 2 oz.; in 2 cases $1\frac{1}{2}$ oz.; and in one case 1 oz. These observations were made in 1845. During the epidemic of 1843 I made the same remark, but at this time imputed it to an error in observation, and made no note of the increase in weight. I presume that in many diseases, the lungs, when empty of blood, will absorb water in this way, and perhaps the extent of this may afford an advantageous measure of the deficiency of blood.

14. The bronchial tubes were dilated in one case; in one case they appeared constricted; in one they were thickened; in 4 cases the longitudinal fibres appeared to be enlarged. In the collapsed lungs generally, these fibres were distinct.

15. The tubes contained blood in one case. In the majority of cases in which there was frothy serum in the lungs, the tubes contained this also. There were

white flaky matters mixed with the fluid. In several instances there was a white adhesive substance in the smaller tubes, particularly in those in which the irregular remains of the cartilaginous rings begin to disappear. I have never seen this in the larger tubes.

In 9 cases the mucous membrane of the larger bronchi was more or less darkly red; in 5 cases it was paler than natural, or greyish; in the remainder it was not perceptibly changed.

16. The antecedent diseases of the lungs were tubercles and emphysema. Unsoftened tubercles were present in small quantity in 3 Europeans. In one Asiatic a cavity existed in either apex, and hard grey tubercles were also scattered through the upper lobes. Pulmonary emphysema was noted in two Asiatics and in one European. It existed partially in three or four other cases.

17. I have been informed that in some cases the lungs have been so congested as to project beyond the thoracic cavity when the ribs were removed. This appearance was not present in any of my cases.

Summary.—The most common appearances in the lungs are, the presence of blood in the large vessels chiefly or solely; the collapse, and the deficient reparation, arising from the more or less complete absence of air and blood, and from the approximation from some unknown cause of the molecules of the pulmonary substance. In other cases there is more blood in the minute structure, a corresponding dark colour of the lung, and a variable amount of frothy serum; the quantity of frothy serum bears an inverse ratio to the degree of collapse.

Heart.—The heart was examined in 23 Europeans and 16 Asiatics:—

	oz.	drs.
The average weight of the heart in 16 Europeans was.....	9	3
Ditto 15 Asiatics	8	$0\frac{1}{2}$
The largest heart among the Europeans weighed	11	0
The smallest	8	4
The largest weighed Asiatics	9	4
The smallest	6	4

1. The perieardium was free from recent disease in 38 cases; in one case there were numerous haemorrhagic points beneath the serous membrane, in the vicinity of the posterior coronary vein, which was much congested. In two cases there was old disease of the perieardium; viz. adhesions in one case, and in another there was a small round body enclosed in a cyst adhering to the perieardium at the base of the heart; it was apparently calcareous, cut with a knife, and weighed 20 grains. In three cases there was a small quantity—about an ounce—of bloody serum in the pericardium, which coagulated immediately when heated.

2. The coronary veins, particularly the posterior, were generally congested. In 21 cases this was remarkably conspicuous. In 17 it existed in a smaller degree. When the veins were full, the cardiae substance generally was dark with blood.

3. The endocardium was darkly stained in almost every case, and in many cases equally so on both sides. In some cases the tint on the right side was darker than that on the left side. I find it noted several times

that the endocardium seemed to peel off more readily than usual.

4. The aortic valves were thickened in two cases, but not in any great degree. In the other eases all the valves were perfectly natural.

5. In the great majority of cases, viz. in 26 out of 39, the cavities of the heart were found in the following state :—The right auricle and ventricle were flaccid, or distended with large fibrinous clots, or with dark semi-coagulated blood ; while the left auricle was partially, and the left ventricle completely and firmly contracted, containing little or no blood, or only a small soft clot. The degree of contraction of the left ventricle may be understood from the following measurements :—The thickness of its walls at the base was, in four cases, 9 English lines ; in two cases 10 lines ; in one ease 11 lines ; in six cases 12 lines ; in three cases 13 lines ; and in two eases 15 lines.* The thickness of the right ventricle was in no ease more than 4 lines at the base, and 2 at the apex, and in the majority of cases the walls were much thinner than this. In four cases the left ventricle was not so firmly contracted, but still the walls at the base were, in three of these cases, more than 9 lines in thickness : the measurements of the fourth case are not given. These were the only cases measured, but on most other occasions the walls of the ventricle are stated to be very thick.

6. In four cases in which the bodies were opened

* I give this last measurement as I find it recorded ; but I think it not improbable that some portion of the columnæ carneæ may have been included.

within fifteen minutes after death, all the cavities were found to be flaccid, but within half an hour after this time, or three-quarters of an hour after death, the left ventricle became firmly contracted, while the right continued as flaccid as before. In other cases in which the bodies were opened as soon after death as in these instances, the left ventricle was firmly contracted as above stated ; so that the flaccidity was not a condition always present immediately after death.

7. In five cases all the cavities were flaccid on opening the body, and remained so. I could not ascertain any reason for this condition. In the subjoined statement of the condition of the blood in the heart, these five cases are numbered as 4, 8, 9, 19, and 39. The quantity of blood in these hearts was small, sometimes clotted, and in one case frothy.

8. Although in many cases the contracted state of the left ventricle seemed to argue unimpaired muscular contractility, and although some bodies were opened within half an hour after death, yet in no case could I excite any contraction, even of the appendices, by mechanical irritation.

Summary.—The right side of the heart and the pulmonary arteries were generally filled, and, in some cases, distended with blood ; the left side and aorta were generally empty, or contained only a small quantity of dark blood. The inference which was drawn from the state of the cavities in the greater number of cases, was, that the right side had continued to receive blood till, in some cases, it became full and even distended, while the left side had received little or no blood, but

had continued to contract, in some cases even violently, on the last drop of blood which had entered it.

The condition of the blood in the heart was noted as follows in the 39 cases :—

CASE I.—Dark liquid blood, with a few small clots floating on it, was contained in the right ventricle.

CASE II.—Four ounces of fluid blood on right side ; on removal it coagulated in half an hour into a soft clot, above which floated a small quantity of serum, stained deeply with colouring matter. In this case the left ventricle was flaccid on opening the body, but contracted firmly in half an hour.

CASE III.—Some dark uncoagulated blood in right ventricle ; a small quantity in left auricle and ventricle. The blood did not coagulate in half an hour, but a cloud of dark colouring matter became deposited at the bottom of the vessel.

CASE IV.—Dark thick blood, with small fibrinous clots floating in it, on right side. The blood was frothy, and disengaged bubbles of gas ; it became lighter in colour when exposed to the air. Two small polypi in left ventricle, interlaced among the columnæ carnæ. This was one of the 5 cases in which all the cavities were flaccid after death.

CASE V.—A small quantity of dark uncoagulable blood on right side. In this case the left ventricle was flaccid when the body was opened, but contracted afterwards.

CASE VI.—No blood in any of the cavities ; a few drops of dark fluid in the aorta. Some blood was collected from the subclavian vein ; in an hour's time it

had not coagulated, but had become of a lighter colour on the surface.

CASE VII.—The right auricle was occupied by a large and tolerably firm polypus ; there was a smaller one in right ventricle, and a small darkish clot in left ventricle. In the right auricle there was, in addition, about 5iss. of dark liquid blood, which did not coagulate any more, but remained liquid and dark, and slowly deposited colouring matter at the bottom of the vessel.

CASE VIII.—A small quantity of blood on right side, but the condition was not noted. In this case all the cavities were flaccid after death.

CASE IX.—About one ounce of dark blood in right auricle ; a small quantity flowed from the venæ cavæ. Condition not noted. In this case, also, all the cavities were flaccid after death.

CASE X.—A small quantity of blood in the right cavities. The vena cava inferior contained blood which was not coagulated in the vessel, nor did it coagulate after removal, but deposited a thick substratum of dark colouring matter. The left ventricle, flaccid at first, contracted firmly in the course of twenty minutes.

CASE XI.—The right auricle contained a small quantity of dark fluid blood. It was not noted whether it coagulated on removal.

CASE XII.—No blood in the cavities ; there was, however, much blood in the vena cava inferior ; when removed from the vein, this began immediately to coagulate, and became lighter in colour on the surface.

CASE XIII.—Very little blood in the heart,—its condition was not noted : in this case the blood from

the root of the lungs was small in quantity, dark, fluid, and uncoagulable.

CASE XIV.—Very little blood either in the heart, pulmonary arterics, or venæ eavæ. Condition not noted. In this case the eavities were all flaceid at first, but the left ventriele contraeted gradually after the body was opened.

CASE XV.—On right side there was much partly coagulated, partly liquid, blood. Some fluid blood was taken from the inferior vena eava ; it was dark, and, after standing for some time, formed a loose semi-fluid coagulum, which did not contraet and expel serum.

CASE XVI.—Blood was eontained in all the eavities ; this was fluid, dark, and did not eoagulate.

CASE XVII.—A small quantity of blood in the right auricle and ventriele ; about an ounce being allowed to stand, it commenced immediately to coagulate, and formed a jelly-like elot, which did not shrink and expel serum, but beeame arterial on the surface. In this ease the blood from the root of the lungs eoagulated and expelled a small quantity of dark serum ; this, being removed from the elot, deposited, after standing some time longer, a eloud of colouring material on the bottom of the vessel.

CASE XVIII.—Fourteen ounecs of dark liquid blood, with floating elots of fibrine, were taken from the right side ; a small quantity from the left : the blood froin the right side eoagulated a little more on removal, but the coagula were soft and loose, and suspended in dark uncoagulated blood, and colouring matter, apart from the clot, was deposited on the sides and bottom of the vessel.

CASE XIX.—Small polypus in right ventricle; the rest of the blood did not coagulate, but a cloud of dark colouring matter was partly deposited, and partly suspended in a red supernatant fluid. In this case all the cavities were flaccid.

CASE XX.—A large polypus in right auricle and ventricle; in addition there were about 8 oz. of liquid blood, which, on removal, did not further coagulate, but deposited a cloud of dark colouring matter.

CASE XXI.—Half an ounce of dark thick blood was drained from the right side; it did not coagulate, but deposited colouring matter at the bottom of the vessel.

CASE XXII.—There was a large quantity of thick blood on the right side; in thirty minutes this formed an imperfect coagulum, which contracted in a slight degree, and expelled serum. The serum seemed to retain some of the colouring matter, which, after standing for some time longer, became deposited on the sides and bottom of the vessel.

CASE XXIII.—A fibrinous clot in right auricle; blood from auricle not further coagulable, but dark and liquid, and depositing colouring matter on standing.

CASE XXIV.—Dark clot in right auricle, stretching into the venæ cavæ. The blood drained from the heart did not coagulate any more, but deposited a loose dark cloud of colouring matter.

CASE XXV.—No clots in the heart. Blood on right side in considerable quantity; on removal it coagulated into an uniform dark clot, which did not, after standing, shrink, or expel serum.

CASE XXVI.—A small, soft, imperfect, excessively

black-looking clot on the right side; none on the left. The blood drained from the heart did not coagulate further.

CASE XXVII.—No polypus in any of the cavities. A few drachms of very viscid blood drained from right ventricle coagulated in half an hour into a firm dark clot.

CASE XXVIII.—Right auricle distended with a large polypus, which stretched into the ventricle and pulmonary arteries.

CASE XXIX.—Dark liquid blood on right side, which did not coagulate after standing for three hours.

CASE XXX.—Large fibrinous clots in right side; a small clot on left side. About 1 oz. of very dark blood was collected from the pulmonary artery, and a smaller quantity from aorta. Being left at rest, it had not coagulated in two hours. Some blood collected from vena cava inferior did not coagulate. The blood from the heart became lighter in colour on exposure to the air; the blood from the vena cava did not undergo any alteration.

CASE XXXI.—Fibrinous clot in right ventricle, stretching into pulmonary artery; a small one in left ventricle: in addition, 4 drachms of blood, collected from the pulmonary artery, was not further coagulable, but became lighter in colour on exposure to the air.

CASE XXXII.—Enormous fibrinous clot in right auricle and ventricle. This seemed to be all the fibrin, as the liquid blood drained from the pulmonary artery did not coagulate, but deposited red colouring matter, and became of a bright hue on the surface. Some blood from the jugular veins coagulated in two

hours into a soft clot; there was also a slight separation of serum.

CASE XXXIII.—Semi-coagulated dark blood in vena cava and pulmonary artery. The right auricle contained a large and soft grumous-looking clot; some smaller dark-coloured and soft coagula lay entangled among the columnæ carneæ. A small soft clot in left ventricle.

CASE XXXIV.—Some soft dark-coloured clots among the columnæ carneæ in right auricle: in addition, a small quantity of dark liquid blood, collected from the pulmonary artery, coagulated after standing for ten minutes; and where the coagulum was thinnest, at the sides of the cup, it rapidly acquired an arterial tint.

CASE XXXV.—The right auricle and ventricle contained a fibrinous clot. Five ounces of dark thick blood was collected from the superior and inferior venæ cavæ; in about half an hour this had slightly coagulated; that is to say, soft coagula floated in the still thick and dark blood.

CASE XXXVI.—Right auricle and ventricle contained a large fibrinous clot. Some dark partly coagulated blood flowed from aorta. A large quantity was collected from the pulmonary artery; it was dark, with soft clots floating in it. After standing for an hour and a half, it did not coagulate any more.

CASE XXXVII.—Large polypi on right side; a small one in aorta. About 3 oz. of dark blood escaped from the superior vena cava, which had not coagulated in two hours. The jugular veins and vena cava inferior contained very little blood, and what there was was dark, thin, and with no kind of coagulum.

CASE XXXVIII.—A large, half fibrinous, half grumous clot on right side; no blood in left ventricle; a small clot in aorta. About three drachms of dark blood flowed from the pulmonary artery; being allowed to stand, in about four minutes it commenced to concrete into an uniform thick clot; where it ran down the sides of the vessel, and was consequently well exposed to the air, it became rapidly arterial in colour.

CASE XXXIX. contained scarcely any blood. All the cavities were flaccid in this case.

I have given these cases in the words in which I originally recorded them, in order to indicate the serious lesions of the blood. When the left ventricle is left unnoticed, it is to be understood as being contracted, and containing little or no blood. The condition of the lungs, as to blood and serum, in the five cases in which all the cavities were flaccid, was as follows:—Case IV. Lungs gorged with serum, and, in some parts, almost black from bloody staining of the tissue. Case VIII. Gorged with frothy serum. Case IX. Little blood from roots; lungs pale, but containing an immense quantity of pale frothy serum. Case XIX.* Little blood from roots; lungs dark, with staining of blood, and, perhaps, extravasation; frothy serum in some parts. Case XXXIX. Large quantity of blood in the substance of the lungs; the lungs were heavy (oz. 45), little collapsed, and lost three ounces by draining.

* Injections into the veins were practised in this case two hours and a half before death.

Summary of the Appearances in the Blood after Death.

The most important physical changes in the blood after death are its coagulation, and its change of colour.

1. In 34 cases the state of the blood in the heart, the vessels of the pulmonary roots, and the large veins, was noted as follows:—In 12 cases there were large polypi or fibrinous coagula in the right cavities of the heart; and in a minority of these cases there were smaller coagula in the left auricle, and more infrequently in the left ventricle. In 7 cases there were small, loose, and generally dark coagula on the right side only. In 7 cases there were no coagula in any of the cavities of the heart, but the blood from the right side coagulated with greater or less firmness on removal. In 8 cases there were no clots in the heart or elsewhere, and the blood taken from different parts remained absolutely incoagulable when removed from the body: in other words, in a little less than a quarter of the whole number of cases, the presence of fibrine in the blood was not indicated by coagulation either in or out of the body. In some cases blood from one part coagulated when it did not from another. I have seen it coagulate from the jugular veins when it did not from the pulmonary artery.

2. In the cases in which the polypi in the heart were of great size, reaching into the pulmonary arteries and the venæ cavae, the remainder of the blood was usually dark, and often somewhat viscid, and did not coagulate on removal; while in other cases, in which

the coagula were small, the liquid blood retained the power of imperfectly coagulating. The polypi were generally of loose texture, containing much serum in their interstices ; sometimes they were remarkably loose and grumous-looking : they were found often in cases opened within fifteen minutes after death, and in some cases probably formed in the last moments of life. In other instances, however, I have been led to believe they had been gradually forming for some time before death. I shall presently have occasion to return to this point. The clots which formed when the blood was removed from the body were also loose and fragile in texture, — sometimes they were almost semi-fluid : they seldom seemed to have the power of contracting and expelling serum ; and, in the few cases in which this happened, the expelled serum was darkly stained with dissolved colouring matter. In the case in which the coagulation was most imperfect, and the clot loosest in texture, the coagulation was as rapid as in the cases where the fibrine was most abundant and firmest. It appeared to me, therefore, from these considerations, that the fibrine in the cases in which there was no coagulation, was not prevented from taking this form by the presence of any foreign substance, but that the complete incoagulability of the blood was only the highest degree of a diminution in the fibrine more or less obvious in the whole range of cases : in other words, judging from the nature, both of the clot after the removal of the blood, and of the fibrinous coagula in the cavities of the heart, the fibrine appeared to be lessened in quantity in most cases, and in some instances to be altogether wanting.

If the defective or imperfect coagulation is not allowed to be a test or indication of an absolute diminution in quantity of the fibrine, it must at any rate be allowed to be the proof of the more or less abundant presence of some agent preventing coagulation.

3. Whether it coagulated or not, the blood had usually a dark colour. On this account it has been variously described by authors as "carbonaceous," "tarry," "unoxygenized." When brought in contact with the air, in thin layers, it generally acquired an arterial tint. This was best shewn by inflating the lungs, when the dark portions immediately became red, and the blood, instead of being thicker, appeared thinner than usual. Sections of lung merely exposed to the air acquired a brighter colour; and the blood collected in a bleeding-basin, from the heart or lungs, in some, though not in all cases, became of an arterial hue as readily as usual. In other cases no change of colour was perceptible.

4. Nitrate of potash, chloride of sodium, &c., added to the blood, always gave a bright arterial hue. The thick substance taken from the intestines had sometimes the same effect. A few drops of this fluid added to the dark blood immediately produced a colour almost as vivid as when chloride of sodium was added.

5. The liquid incoagulable blood or the serum removed from the heart, when there were large coagula in its cavities, presented the appearance of a thickish, dark fluid, which gradually, after the lapse of 24 or 30 hours, deposited a loose cloud of colouring matter; the supernatant serum was seldom colourless, but a portion of

haematosine appeared to be dissolved in it. The serum contained abundance of albumen, and always coagulated firmly on the application of heat ; it contained also some of the salts, as it never failed to give with nitrate of silver a dense curdy precipitate, becoming dark on exposure to light.

6. Under the microscope no alteration could be seen in the form of the red particles. I may mention that in some cases they seemed to have lost their power of running together, and applying themselves side to side, or if they did this, it was much more slowly than usual.

Summary.—It appeared probable from all the observations, that there was a deficiency in the quantity of fibrine, or a great tendency to the separation and deposition of this ingredient ; that albumen and salts were present in undetermined quantity ; and that the red particles were sometimes partly dissolved in the serum, but not in other cases appreciably altered in figure and appearance.

ABDOMEN. *Liver.*—The liver was examined in 23 Europeans and 16 Asiatics :—

	oz.	dr.
The average weight of the liver in 19 Europeans was	45	3
The greatest weight	56	0
The smallest	36	0
The average weight in 15 Asiatics.....	34	1½
The greatest	41	0
The smallest	27	4

1. There was occasionally some blood in the larger branches both of the vena portae and the hepatic veins ;

but the minute texture was in almost every instance empty of blood. Some blood issued on section from the larger branches of both sets of vessels in sixteen cases; from the vena portæ only in four; from the hepatic veins only in four. There was central congestion of the lobules in three cases, and peripheral congestion apparently of the portal system in one. In ten cases there was no notable increase of blood in any system of vessels. The liver lost on an average of fifteen cases, in Asiatics, by cutting, washing, and draining for two minutes, 3 oz. 1 dr. in weight. By a similar process, in ten Europeans, it lost only from six to ten drachms in weight.

2. No marked change in the molecular structure was traceable by the eye. In two cases the lobules were indistinct; in two there were superficial patches of a pale lemon colour; and in two the surface was mottled. The colour generally varied as follows: it was pale in twenty-one cases, and in some of these it was paler than natural: it was dun-coloured in two cases; light red in two; pale slate-coloured in three, and of a dark slate colour in five. In consistency the liver was noted as soft in one case; in the remainder there were no obvious recent changes.

3. The antecedent diseases were, thickening of the scrous coat, and adhesions to the surrounding parts in three cases; enlargement and commencing cirrhosis in two; and fatty degeneration to a considerable extent in two cases.

4. In several cases bile was contained in considerable quantity in the larger hepatic ducts, and issued from the portal canals on section. In one case this was of

a green colour ; in all the other cases it was of a light orange.

5. The gall-bladder was generally only moderately full of bile. In seventeen cases the quantity was measured ; the largest quantity was 3 oz. ; the smallest 3 dr. ; the average $1\frac{1}{2}$ oz. In nine other cases the quantity was noted as considerable, and in the remaining cases as small. The mucous membrane of the gall-bladder was stained yellow in three cases ; it was green in six cases, and minutely vascular in two. In the remaining cases its condition was not recorded.

6. The bile presented a singularly uniform appearance, and is almost always described in the same words. It was rather thick and viscid, generally homogeneous, of a dark yellowish-green colour in mass, but of a bright yellow in thin layers. In one case there was a green precipitate in it, and in several instances it contained yellow, and apparently crystalline particles, which were only partly soluble in hot alcohol ; the alcoholic solution never afforded any cholesterine.

7. In seven cases the ductus communis choledochus was carefully dissected *in situ*, and was seen to be pervious throughout. In these, and in other cases, the bile could be forced with perfect facility along the duct into the duodenum, and there was certainly no obstruction after death to the free passage of the bile.

Summary.—There was some accumulation of blood in the larger branches of the vena portæ and hepatic vein ; the gall-bladder was moderately full, and the bile thick and viscid, but not stringy, as in some cases of dysentery.

oz. drs. grs.

Pancreas.—The weight of the pancreas in the Europeans, on an average of fourteen cases, was 2 6 $\frac{1}{4}$ 0
In Asiatics the weight was slightly below this.

Nothing unusual was observed in any case.

Spleen.—The spleen weighed, on an average of eighteen cases, in Europeans ... 6 4 42
Ditto, fifteen Asiatics 4 3 30

From the average of the Europeans two cases are excluded, in which the spleen was enlarged in consequence of repeated attacks of ague and remittent fever.

1. Old adhesions with surrounding parts existed in three Europeans and in one Asiatic. In this latter case there was a false membrane on the superior surface of the spleen, fully six lines in thickness ; in another European the proper coat was thickened and pucker'd, but there were no adhesions.

2. On section, the spleen did not present any notable marks of disease ; its colour was dark red in thirty-five cases ; in one case it was unusually dark, and in two cases unusually pale.

3. The spleen was generally contracted, and contained very little blood ; in thirty-six cases its consistence was noted as "firm ;" in three cases in Europeans it was softened. The diminution of consistency seemed in these three cases to be attended by enlargement ; for in one ease the spleen weighed 6 $\frac{1}{2}$ oz., in another 8 $\frac{1}{2}$ oz., and in a third 11 oz.

4. Several writers, and among others Mr. Twining,

have described the spleen as enlarged and congested : I have found this to be very seldom the case. Among the Asiatics, in only three cases did the spleen reaeh the size of 7 oz., and in one of these of 10 oz.: two of these eases were Burmans, the other a Bengalee. The largest undiseased spleen among the Europeans weighed 11 oz., and the smallest 3 oz.

Kidneys.—The kidneys were examined in 23 Europeans; and in sixteen Asiatics.

	oz.	drs.	grs.
The average weight of the right kidney in nineteen Europeans was	5	1	15
Ditto left	5	3	53
Ditto right			
in fifteen Asiatics was	3	4	
Ditto left	3	3	

1. The strueture was apparently unaltered in every case among the Europeans ; in one Asiatic there was decided evidence of an early stage of Bright's disease.

2. In some eases there was a little congestion of the eortieal substance ; there was often a minute speekled appearance on a pale ground.

3. In some cases there was a white milky fluid in the pelvis of the kidney, looking often very much like pus, but soluble in alkalis : this appearanee, of eourse, is eommon to many diseases besides cholera.

STOMACH. 1. The stomach was often distended with a watery, pale, or subalbid, or yellowish, greenish, or greyish fluid. This was not coagulable by heat, but gave, in several experiments, a dense curdy preeipitate with nitrate of silver. The contained fluid often smelt

strongly of medicines which had been taken even a considerable time before death; and in three or four cases, when pills of acetate of lead had been given, portions of this remedy were found firmly adherent to the mucous membrane.

2. When the stomach was less distended, it was corrugated, and the mucous membrane was as rugose as the stomach of a dog; or if the body were opened very soon after death, and the fluid removed, the stomach immediately assumed this contracted form.

3. The external surface was usually pale; in a few instances there was a light vermillion flush.

4. The mucous membrane presented venous congestion in several cases. In three there were minute red striæ, and points of haemorrhagic congestion; in one case there was softening: in all the remainder the consistence of the membrane was unaltered.

5. The veins of the omentum and the mesocolon were generally turgid with blood.

Small Intestines.

1. The peritoneal coat presented a vermillion flush in eight cases out of thirty-nine. It presented a fainter flush in two cases. In twenty-nine cases it was not perceptibly changed.

2. The intestines appeared generally dilated, and in every instance contained more or less of a peculiar fluid presently to be described.

3. The alterations in the mucous membrane con-

sisted of various shades of redness and of glandular changes ; there were either patches of redness, or a diffused hue, more or less dark, varying from a pink to a brown colour, or punctiform haemorrhagic patches, in twenty-six out of thirty-nine cases. It was generally in cases where the redness of the mucous membrane was conspicuous that the peritoneal vermillion flush was most marked. The consistence of the mucous membrane was unaltered.*

4. The agminated and solitary glands were enlarged in the majority of cases : this enlargement, however, differed exceedingly in degree. In twenty-two cases the agminated glands were considerably, and, in some cases, greatly enlarged ; in fifteen cases they were visible, but not apparently increased in size : in two cases they were not seen at all. The solitary glands were much enlarged in sixteen cases ; they were slightly enlarged in eight cases, not seen at all in two cases, and of their usual size in thirteen cases. When the Peyerian glands were small, the solitary glands were generally well developed ; and the reverse. When the agminated glands were enlarged, they were generally raised above the surrounding membrane to the extent of one, two, or even three lines. They were often minutely vascular, both over their surfaces and at their peripheries : they had a fine fleecy, or pilose look, or presented alternate opaque and transparent spaces. Sometimes they had a brownish colour. They often commenced to be seen within three

* This observation is at variance with the statements of several French and two or three English writers.

or four feet from the pylorus, crossing the valvulae conniventes, and did not observe any constant rule of increased development towards the cæcum. The solitary glands were occasionally surrounded by a red basic zone, but more generally perhaps they were quite pale, or presented a dark colour, which was very well marked in two cases.

The relation which the changes in these glands, and the general redness, bore to the vomiting and purging, is a difficult problem. I think they were decidedly most conspicuous in the least severe, and in the prolonged cases, which were generally those attended with the greatest amount of purging: probably they were merely a consequence of the purging, and of secondary importance.

5. There was no ulceration or sloughing of the agminated glands in any case. Ulceration occurred in two cases—one in an European, and one in an Asiatic; and, in both instances, originated, to all appearance, in the solitary glands. In the first case the ulcers were situated in the ileum; they were twelve in number, very minute in size, and each was placed in the centre of a white, raised, and enlarged gland. In the second case the ulcer was single, situated in the ilium, 3 lines in length by 2 in breadth. Its long diameter was across the intestine; two or three solitary glands were near it, and partly formed its sides: its floor was formed by the submucous tissue, and was crossed by conspicuous red vessels. There were a few radiating vessels in the mucous membrane around it. The

solitary glands in this case were universally enlarged ; the agminated glands were little developed : in all the intestine there were only two slate-coloured patches, very little raised above the surrounding membrane, and not situated in the neighbourhood of the ulcer. In both these cases it appeared probable, from the appearance of the ulcers, that they were not of recent formation. In the case of the European, there were tubercles in the lungs, and the minute ulcers looked very much like the commencing iliac ulcers of phthisis.

6. Brunner's glands, in the duodenum, were often enlarged, and surrounded by red basic zones. In two or three prolonged cases they were stained deeply yellow.

Large Intestines.

1. In about half the whole number of cases the colon was contracted. The degree to which the contraction was sometimes carried was extraordinary ; it did not seem to bear any relation to the amount of purging, but its occurrence was almost always denoted by severe pains in the loins commencing from one to four hours before death.

2. The peritoneal surface was pale in every case : the mucous membrane was normal in consistence ; it presented slight vascular patches in several cases, and in one case it is noted that there were two or three patches of blood beneath the mucous membrane. In the contracted or corrugated condition it was pale or ash-coloured.

3. The glands were visible in every case. In eight

cases they were much enlarged ; sometimes they presented dark central specks or dots ; in cases where they were most enlarged these were absent. They had a singular slate or lead colour in three cases, and red basie zones in about the same number ; they were not ulcerated in any ease.

Contents of the Alimentary Canal.

The fluid effused into the alimentary canal is one of the constant after-death appearanees. In the stomach this characteristic fluid is often mixed with foreign and extraneous matters ; in the large intestines it is seldom found in great quantity, as it seems to be expelled with violence whenever it enters this portion of the canal. It is neecessary, then, to detail its characters only as it presented itself in the small intestines.

The colour of this fluid was white, subalbid, or of a light-grey yellow, or ehocolate tinge ; the darker tints were, however, only varieties present in prolonged cases, and probably dependent on a particular condition, viz. the passage, in greater or less quantity, of blood-corpuseles. The fluid consisted of a thinner and a thicker portion, and its consistence varied according to the varying quantity of these component parts. The thicker portion was flaky, stringy, curdy, or clotted : it was not spread uniformly over the surface, but lay in masses here and there, as if it had been deposited from an agitated fluid : some of these masses, or bundles, often adhered with considerable firmness to the mucous membrane, and were detached with diffi-

culty from between the valvulae conniventes. It had a peculiar albuminous or caseous smell, more developed by heat.

The amount of this clotted flocculent substance, and of the thin fluid, varied so much, that it would be impossible to state any average quantity. In one case three pints were measured, but there was sometimes much more than this, and sometimes less. Sometimes the intestines were much distended, and the fluid gushed out on puncture in a jet.

The thin serous fluid became cloudy and turbid by heat in some cases, but in the majority of instances it resembled the thin serous stools in being incoagulable. It precipitated nitrate of silver in every case ; at least I have made no note of any case in which this did not occur, and the experiment was tried many times. Occasionally there was an alkaline reaction, but this was not constant, and I have neglected to note the number of times of its occurrence.

When the clotted substance was separated from the thin fluid and heated in a solution of Liq. Potassæ, or of Carbonate of Soda, it dissolved with greater or less facility. In ten trials the solution was almost or quite perfect ; in a few other cases a portion was left undissolved. Nitric and sulphuric acids immediately gave a copious white precipitate when added to the alkaline solution. Dr. Christie states that this substance "is soluble in acetic acid, and is precipitated by prussiate of potash."* I found, however, that it

* Dr. Christie on Cholera, p. 52.

was only occasionally soluble in acetic acid; when heated with this acid in three experiments the substance lost its flaky albuminous look, and acquired a gelatinous appearance; the portion thus gelatinized was dissolved immediately by alkalies. Acetic acid also occasionally precipitated the alkaline solution, and occasionally had not this effect, but produced only a slight turbidity.

There can be no doubt that the true choleraic congee or rice-water stools are a portion of this peculiar fluid, the thinnest parts of which seem only to pass off, while the thicker clotted portion is in a great measure retained; the representative of it in the stool is to be found in the little white shreds or flocculi which give the watery dejection its characteristic appearance. The two component parts of the stools, viz. the watery part and the white flocculi, give similar chemical reactions to those of the serous and the clotted portions of the intestinal fluid. The watery portion is occasionally alkaline in reaction, is incoagulable by heat in the majority of cases, though not in all, and precipitates nitrate of silver. The white flocculi are dissolved by alkaline solutions, and are again precipitated by the stronger acids.

There can be little doubt, judging from these experiments, and from the observations of other writers,*

* I need only refer to the observations of O'Shaughnessy, who found the effused matters to consist of water, salts, albumen, and casein.

which I need not detail here, that the fluid in the intestinal canal and the peculiar stools consist of part of the water and salts of the blood mixed with a proteine constituent.* That the greater part of the proteine

* This conclusion is totally at variance with the opinion of Andral, as given in a note lately read before the French Academy, (*Gazette Médicale*, No. 33).

Andral states that the effused white substance is not fibrine, or any other constituent of the blood, but merely modified mucus. The reasons for this opinion are not stated, nor does it appear whether reference is made to cases of epidemic or of common sporadic cholera. If only to the latter, it is premature to generalize the observation, as the question of identity of the two diseases is still a doubtful point, although the probability is in favour of the identity.

Nothing is more opposed to my whole course of argument than the idea of an increased secretion in any part of the body being an accompanying phenomenon of the algide cholera ; and I may state that the opinion that the clotted substance in the intestinal canal is a secretion, was one which I formerly adopted, until I became convinced that such a notion was at variance with what was known of its chemical properties, and was, as I conceived, irreconcileable with the whole course and progress of cholera. But, in calling this substance an exhalation, I do not mean to assert that the fibrine is not altered during its passage from the capillaries through the basement membrane and epithelium into the intestine, where it becomes insoluble : it may undergo some change, especially in the slighter cases ; or it may become mixed with an unusually abundant exfoliation of epithelium, &c. This is to be anticipated, and the microscope will probably soon prove it. By the term exhalation, I only mean to state that none of the ordinary well-recognised products of secretion are to be found in the intestinal canal. It is obvious that, in the slightest cases of even the algide cholera, the changes in the blood are not so

constituent consists of fibrine, also appears probable ; but albumen is undoubtedly sometimes present, as proved by the coagulability of the thin fluid ; in other cases, if this ingredient be present, it seems to have assumed the insoluble form immediately after being poured into the canal.

Referring now to the state of the blood as already described, it is impossible to avoid connecting these two observations together : that whereas the blood was generally deficient in its power of coagulation, or was altogether destitute of this property, or in other cases separated the fibrine more readily than usual,—so in the intestinal canal a substance was found which presented many of the physical and chemical qualities belonging to the ingredient which appeared to be wanting in the blood.

Urinary bladder.—Contracted in every case, sometimes to an excessive degree.

great, and the powers of life are not so depressed, as to arrest all the secreting power of the intestinal mucous membrane. In these cases it is very possible that secretion and exhalation may proceed together until the severity of the disease arrests first the one and then the other.

With this proviso I leave the question of the nature of the clotted substance to be determined by future observation.

CHAPTER III.

SYMPTOMS OF CHOLERA CONSIDERED SEPARATELY.

THE symptoms of Cholera are, after a certain stage, peculiarly definite and characteristic. The effects of temperament, of original or acquired constitution, of age, and other circumstances, which generally exert so powerful a modifying influence on morbid poisons, seem, as it were, incapable of affecting the course of the virulent virus of Cholera. One case is, in all its essential features, a copy of all cases, and, with endless degrees of intensity, the symptoms present little variation in their mode of succession, and in the influence they exert on each other. Consequently, in the latter stages of a case of Cholera, the numerical method on a large scale may be considered to be of little use, as the conclusions drawn from a few cases are of equal accuracy with those drawn from a great number ; and this, perhaps, is true even of the whole course of the disease ; for, although a great variety of symptoms have been described as occurring in the early stages of Cholera, it appears to me that this has arisen from attempts to include in one description all the anomalous forms of disease which are known to prevail during the prevalence of epidemics ; and, if we exclude all such anomalous and obscure cases, and restrict the term

Cholera to the form I am about to describe, we shall isolate a peculiarly well-marked disease, presenting great uniformity in symptoms, and having a definite course and termination.

When a case has so far advanced that it presents the unequivocal and characteristic phenomena of the Algide Cholera, the following are the chief symptoms :—More or less vomiting and purging of a peculiar fluid, cramps, sweating, suppression of urine, thirst, diminished circulation, and impeded respiration, causing coldness of the tongue, surface, and breath, lividity of the lips and skin, alteration of the voice, lessening of the respiratory murmur, diminution or absolute disappearance of the pulse, and at last complete arrest of the circulation.

It is necessary to consider these symptoms separately before entering on the discussion as to their mutual relation and combination.

I possess accurate notes of forty-seven cases of cholera fatal in the so-called blue or collapsed stage. These patients were all adult males, and either soldiers or convicts ; thirty-one were Europeans, and sixteen Asiatics. I have notes of many other fatal cases, in several different nations, but these were not taken with sufficient care to allow me to use them, except as corroborative and occasional evidence. The following analysis is derived altogether from the symptoms present in the fatal cases, and in thirty-nine of these, post-mortem examinations were made. I have occasionally made use also of some of the cases fatal from consecutive fever.

1. Duration of the disease in the fatal cases.

In the forty-seven fatal cases, the average length of life after the patient was first seen by a medical man, and was undoubtedly labouring under Cholera, was fourteen hours and three-quarters. If the thirty-one Europeans be separately considered, the average is reduced even below this, being only ten hours and three-quarters. The average of the cases in the sixteen Asiatics is, on the contrary, raised, being twenty-four hours. The reason of this difference in favour of the Asiatics probably is, that the cases of the Europeans were taken during the height, while those of the Asiatics were taken towards the close, of an epidemic. The greatest length of time that an Asiatic was in hospital was ninety-seven hours, and the next greatest, sixty-nine; the shortest time was one hour, and in ten of the remaining thirteen cases, the time was below twenty hours. Of the Europeans, the greatest length of time a case was in hospital was thirty-six hours, and the shortest time four hours. Of the whole thirty-one cases, there were only two longer than twenty hours. If, instead of calculating the time from the patient's admission into hospital, we take it from the first stool, or from the period assigned by each individual as the commencement of his illness, the average length in forty-one cases was twenty-seven hours and a half.

2. Passage of fluid from the mouth and anus.

Of the forty-seven fatal cases, five had no purging after

admission into the hospital; of these five, two had also no vomiting; two had each one attack of vomiting, and one had several violent attacks. Forty-two cases had more or less vomiting and purging after admission; the average number of stools was five; the greatest number in any one case was twenty-six; the next greatest twenty-two; six cases had between ten and twenty; twelve between five and ten; sixteen some number less than five, and in six the number was uncertain, but was considerable in three.

In five cases out of forty-seven there was no vomiting after admission, and in two of these cases there was also no purging. In the remaining cases vomiting was more or less present. In one case there were "constant attempts;" in several, attempts after taking medicine or liquid. In nineteen cases the number of times is recorded, and gives an average of three, but I believe this to be much below the real number, and, in fact, attacks of vomiting recur and cease so suddenly, and are induced by such slight causes, that unless a patient be constantly watched, they may be easily overlooked.

The quantity of fluid ejected by these means from the intestinal canal is estimated with difficulty; the vomited fluids are mixed with the liquids so eagerly taken to appease thirst, and it is difficult even to collect the fluid passed by stool. In only one case did I succeed in satisfactorily measuring the whole quantity; the patient had seven stools, and passed eighty-eight oz. of fluid. In this case, as in many others which I have measured, the stools varied infinitely in quantity,

being sometimes more than a pint, sometimes less than an ounce. In the cases in which there was no purging, the characteristic fluid was found in the intestinal canal after death.

All the forty-seven patients had vomiting and purging previous to being admitted into hospital. Twenty-four were able to mention the number of stools they had had during this period. One patient said he had been purged fifty times; one forty times; one nineteen times; two twelve times, and nineteen had been purged some number less than ten; of these, one had been purged only once, and this case had only one stool after admission. The average of the whole number of stools before admission was a fraction less than ten, or, if the three highest cases be excluded, six and a half. Twenty-three patients could assign no number of stools; three said they had been more or less purged for four days; one that he had been purged for two days; ten that they had been purged a great many times, and nine that they had had several stools.

In twenty-one cases in Europeans, the period of the last stool before death was carefully noted. In one case, this was twelve hours; in two cases, nine hours; in three, eight hours; in two, seven hours; in nine at various periods, between two and six hours; in one case, one hour; in two, thirty minutes; and in one, less than fifteen minutes. The average of the last stool was about five hours before death.

The nature of the stools in these forty-seven cases, as witnessed after their admission into hospital, has been already described in treating of the fluid in the

intestines. I shall now only mention the varieties. Occasionally the stool was almost limpid, with a very few shreds or flocculi floating in it: in this case, the quantity was usually large, and the period of occurrence was in the early stage. The rice-water stool, with more numerous flocculi, was seen also in this stage. The liquid occasionally was thicker, white, or curdled; sometimes very much like white of eggs, partly beaten up. This kind of stool also possessed the peculiar smell more strongly than the others: sometimes the white portion was so well mixed up with the watery part as to give an uniform white or milky look to the stool. The darker shades of grey, or chocolate colour, were more generally seen in prolonged cases, or in those passing into the consecutive febrile stage.*

The phenomena of the disease coincident with the purging and vomiting, and the real value of these symptoms as diagnostic marks, can be considered only after an examination into the next symptoms—viz. the cramps, and the impairment of the processes of circulation and respiration.

* Although the true choleraic stools were present in all these cases when first seen, I have seen many cases at the commencement of the attack, and found the rule always to hold good, that, except in the very severe cases, the earlier stools are limpid and watery, or mixed with faeces; or are brown or dark-yellowish in colour: they assume the rice-water flocculent character gradually.

3. *Cramps.*

In four cases out of fifty-two there were no cramps at any time ; in three others, the patients were not seen until after some time, and the cramps had ceased : in the remaining forty-five cases, cramps of greater or less intensity were present. Of these cases, twenty-five, in Europeans, were seen before the occurrence of cramps, or very soon afterwards. The coincident phenomena were, therefore, carefully noted ; and as the period when cramps commence is one of the most important points in the discussion, I shall consider it somewhat at length.

CASE I.—In this case there had been loose purging for some hours. Urine was passed at four P.M. ; cramps in the thighs only, came on at ten minutes past eight P.M. At the same time the Report mentions that the skin was cold,* with clammy sweats ; the pulse at the wrist very small, 100 ; there was vomiting of limpid watery matter ; the voice was husky and low, and the breath was short. At nine P.M. the patient had had one copious watery stool, and had vomited twice ; the cramps had extended to the legs and hands ; the

* I employ the term cool, to express a very moderate lowering of the temperature ; cold, when the lowering is marked and unmistakable ; and icy cold, when the surface has the deadly chill of the advanced stage. These terms are necessarily vague. I have to regret that greater precision was not given, by the use of the thermometer.

skin was cold and moist ; the pulse imperceptible ; the voice nearly lost ; the face dark and purplish ; eyes sunk ; lips livid : respirations twenty-eight per minute, and shallow.

CASE II.—This patient was attacked suddenly with vomiting and purging, at half-past one A.M. I saw him at two A.M. The skin was cold and moist ; the pulse small ; the tongue and breath cold ; there was oppression and pain at the praecordia ; the voice was hoarse ; there was deafness, and great thirst. While I was noting these particulars, violent cramps came on for the first time in the legs, thighs, arms, and shoulders.

CASE III.—I first saw this case at a quarter-past ten A.M. The patient was pale and faint, and complained much of noise in the ears. He had vomited once or twice, and had been purged several times, but did not know the number : an hour previously he had passed a large quantity of urine. The skin was cool and moist ; the tongue cool ; pulse feeble ; there was tightness across the chest, and dyspnœa ; the voice was raised in note, and shrill, yet husky. There had been no cramps. At a quarter to eleven A.M. he had great noise in the ears, purging, stools watery, whey-like ; vomited matter the same ; skin cold ; fingers corrugated ; eyes sunken ; complete cholera visage ; tongue white and cold ; breath cold ; eyes injected ; voice hoarse ; dyspnœa and tightness across lower part of thorax. Cramps came on for the first time in the hands. At half-past eleven, there were violent cramps in both upper and lower extremities.

CASE IV.—This patient was first seen at a quarter

to three A.M. There was vomiting and purging, but there were no eramps till a quarter past four A.M., when they eame on in the legs. At this time the skin was eold ; the eyes sunken ; visage choleraic ; the pulse fluttering, and there was great dyspnœa.

CASE V.—This patient was admitted at six A.M. The skin and tongue were eold ; the pulse feeble, 72 ; there was giddiness, and noise in the ears ; the voiee was low and husky. He had passed urine immediately before admission. There were no cramps till seven A.M., and then they were slight. At twenty minutes past seven, severe eramps in the legs came on : at this time the symptoms referrible to the eirculatory and respiratory functions were still more fully developed.

CASE VI.—Admitted at a quarter past eight A.M. Had had four stools, and had vomited once ; passed urine immediately before admission ; surface eold ; voiee low and husky ; pulse small, 80 ; tongue white and eold ; lips livid ; eyes sunken ; choleraic visage ; dyspnœa ; respirations twenty per minute. At nine A.M. eramps eame on for the first time in the lower extremities, and speedily extended to the upper.

CASE VII.—This man, a patient in hospital for gonorrhœa, after some purging during the night, reported himself ill at half-past five A.M., at which time he was first attaeked with severe spasms. He was seen immediately, and was found eold, pulseless, and livid ; the tongue was eold ; the eyes sunken ; the breathing shallow ; the voice a whisper ; the fingers shrivelled, and the nails blue.

CASE VIII.—This patient was seen at twelve meridie.

He was cold, with sunken eyes and altered voice. He said he felt a strange dizziness in the ears. The pulse was 108, small and feeble ; tongue cold and white : he had had no spasms. Two hours afterwards he had cramps in the right leg, which lasted only a few minutes, and then disappeared altogether, and did not again return.

CASE IX.—The patient was seen at seven A.M. He had been more or less purged for twenty-four hours, and had vomited once. The tongue was white and cold ; the extremities of the fingers cold ; the trunk warm ; the pulse was hardly perceptible. There were frequent cutting pains across the abdomen, but he had had no cramps. At eight A.M. he had a scanty rice-water stool, and at the same time severe cramps in the legs.

CASE X.—This patient was admitted at three A.M., having had seven watery stools, and been vomited. On admission, he felt giddy, faint, and deaf ; the skin was very cold and dry ; the tongue was cold and pale ; the eyes sunken ; the lips livid ; the voice hollow and husky ; the pulse small and slow ; the respiration already slightly laborious ; great thirst. He had had no cramps. Five minutes after his admission, he had a serous stool, Oiss. in quantity. At half-past three A.M. he had a perfectly limpid stool, twelve ounces in quantity. At a quarter to four A.M., a serous, or rice-water stool, six ounces in quantity, and cold clammy perspirations broke out. At four o'clock A.M. he had for the first time cramps in the legs.

CASE XI.—Admitted at four P.M. He had slight

lividity of countenance ; tongue, surface, and extremities cold ; pulse weak. There had been five watery stools since he was first taken ill, but no cramps. Soon afterwards he had a copious watery stool, with flocculi floating in it ; and at five P.M. complained of cramps in the feet and legs. At this time the tongue was cold ; the extremities cold ; the pulse scarcely perceptible ; the voice husky, and the eyes sunken.

CASE XII.—At six A.M. this patient was first seen. He had been much purged in the night : the skin and tongue were warm, but the pulse feeble. At half-past six he vomited a fluid like rice-water, and immediately complained of slight cramps in the legs ; the voice was altered, and the pulse small. At seven A.M. the cramps in the legs became more severe ; the countenance was slightly livid ; the tongue cold ; the extremities also cold ; the voice very weak and husky.

CASE XIII.—This case was admitted at six P.M. At the time of admission, he was covered with profuse, clammy, cold perspirations ; the eyes were sunk ; the skin of fingers shrivelled ; the pulse frequent and small ; the tongue cold and moist, and the voice low. There were also violent cramps in the legs and abdomen, which had only just come on.

CASE XIV.—Admitted seven A.M. Had been ill only an hour, had had one loose stool, and had passed urine at the same time : no vomiting. On admission, the skin was cold, and covered with perspiration ; the pulse feeble and quick ; the tongue white and cold ; the voice low, hollow, and roughened. Immediately after admission he vomited a greenish

fluid, and had a very large loose faeculent stool. At eight A.M. cramps in the legs came on for the first time.

CASE XV.—This man had slight cramps in the legs at three A.M. The case was not noted, however, till twenty minutes past five A.M. At this time the pulse was 64, of pretty good volume; the skin and tongue were cool; there was thirst: and, immediately after admission, he had a rice-water and flocculent stool, one pint in quantity.

CASE XVI.—This man was admitted at seven A.M., stating that he had had loose purging for two days. The skin was warm, and the pulse natural. At ten A.M. he had had five stools; the skin of the trunk was rather cool; of the hands, cold and clammy; the tongue was cold; no tightness across the chest; no nausea or vomiting; the voice was raised; there was faintness, vertigo, and, at times, partial syncope. Severe cramps in the calves of the legs came on at this time.

CASE XVII.—Admitted at half-past one P.M. Six watery stools; skin cold and clammy; tongue moist, whitish and cold; pulse small; voice raised. At two P.M. he had vomited twice, and had had one stool. Cramps came on at this time in the lower extremities.

CASE XVIII.—This patient, on admission, was suffering from spasms in the legs and arms, which had just come on; the pulse at the wrist was exceedingly small and feeble; the voice not much altered; the features were collapsed; the visage choleraic; the breath was cold, and the skin cold and clammy.

CASE XIX.—The case was admitted at half past

nine A.M. There were no cramps until twelve meridie, when they came on slightly in the left leg. The pulse was small, 90 ; and the visage choleraic.

CASE XX.—Admitted at three A.M. At this time the pulse was very small, and hardly perceptible; the tongue cold; the skin bathed in perspiration. A few minutes after admission cramps of the stomach came on: at four o'clock, the spasms were severe in the toes and calves of the legs.

CASE XXI.—Admitted three P.M. The patient was violently purged all night; had had seven stools in the last five hours: passed urine half an hour before. Stools watery greyish, but without white flocculi; vomited matters watery and curdy; pulse of tolerable volume; skin cool; tongue cool; no cramps; eyes sunken; lips not livid; respiration easy; murmur audible. At four P.M. he had a milky stool, with a caseous smell; the visage now became choleraic; the voice raised; the pulse very feeble. He had six scanty stools up to ten minutes to seven, when the Report mentions that slight cramps were just commencing.

CASE XXII.—Admitted seven A.M. Had been purged four times; no stool after admission. Soon after admission, had vomiting; the pulse was feeble; the countenance livid; the skin dry; the tongue cold, white, and moist. Cramps now came on, chiefly affecting the thighs, and particularly the rectus of left thigh.

CASE XXIII.—Admitted ten A.M. Has been ill for an hour and a half; four stools; no cramps. On admission, he was purged as he entered the ward; the

stool was watery ; violent cramps came on for the first time ; there was great thirst ; the skin was bathed in a cold perspiration ; tongue moist and cold ; eyes sunken —dark circle around them ; lips livid ; voice squeaking and shrill ; pulse 130, very feeble.

CASE XXIV.—This patient had been ill four hours when admitted, and stated that he had had forty stools in that time, and had slight cramps just before admission. On admission, he had severe cramps ; the voice was failing ; the surface and tongue cold, and the pulse very small and rapid.

CASE XXV.—Admitted eleven A.M. Surface cold ; tongue white and cold ; dizziness and faintness ; eyes rather sunken ; voice at times husky, at other times natural. At two P.M. he had one stool, watery, and with flocculi : one attack of vomiting of a clear watery fluid. The surface was cold and moist ; the voice was husky, and at times whispering ; the tongue cold ; dizziness, vertigo, and partial syncope. At three P.M. he had another stool. At five P.M. three more scanty stools. At this time slight cramps came on in the left thigh, which lasted only for about ten minutes, then disappeared altogether till half-past seven, when they came on again for a few minutes, and then finally disappeared. There was no vomiting or purging after five o'clock.

It appears from these cases that at the period of the first commencement of cramps, the changes in the circulation and respiration were always well marked, and in many cases formed the prominent symptoms.

In the remaining twenty cases, cramps were present

when the patients were first seen ; and at this time the failure of the circulation and the embarrassed respiration were very great. It is a fair inference that these cases would have presented the same symptoms in a less degree at the time when the cramps first appeared, if the patients had been then seen.

It may be questioned whether it is fair to generalise from these fatal cases, and to conclude that serious disorder in the circulation and respiration always precedes cramps in cholera, when we often witness cases in which severe spasms are combined with a hot skin, and even with a full pulse. But these cases are not, I think, instances of true Cholera ; they are only one variety of the premonitory stage : this is proved by the fact that the vast majority of them recover, and regain perfect health without any consecutive fever—a very rare occurrence in the acute form, and that when they prove fatal they do so by a gradual transition into the severe form, and by steps easily recognised and defined.

Such are the coincident phenomena at the period of the commencement of cramps, but cramps usually are absent for some time before death ; what, then, are the phenomena attending their cessation ?

In twenty-two cases in Europeans, in which the period of the cessation of cramps was carefully noted, the longest period before death was nineteen hours, and the next longest ten. In seven cases it was between ten and five hours. In thirteen it was under five hours. The shortest period was one hour, and it was less than two hours and a half in four cases. The average was five hours and a half before death.

At this period the arrest of the circulation and the impaired action of the respiratory organs were marked in the highest degree : the observation, in fact, accords with the experience of every one, that cramps cease some time before death, while the arrest of the circulation is gradually going on.

At this time also the purging and vomiting had generally ceased. The average periods of the cessation of the stools and cramps nearly accord, being in one case five, and in the other five hours and a half before death. The periods do not always agree in any particular case.

The kind of stool invariably present, when cramps prevailed, was of course the true choleraic, serous, or rice-water stool, containing flocculi. Except in the case just referred to, and to which I shall presently return, I never witnessed cramps where the stools did not possess this character. But very severe cramps were present in one case in which there was no purging ; in this instance, however, there was a great quantity of the white curdy substance in the canal after death. They were absent in four cases ; in three of these there was very little purging, but in the only post-mortem examination, in one of these three cases, there was certainly a curdy substance in the canal, though not to any great amount. The fourth case furnished some of the few anomalous symptoms seen in Cholera ; the patient had six stools after admission into the hospital ; the abdomen was tumid and painful ; the stools were at first quite watery, and became afterwards of a pale yellow colour without flocculi ; the pulse remained per-

ceptible till death, but there was terrible dyspnœa and delirium, and the man died suddenly and unexpectedly in convulsions. On examination the organs presented the appearances incident to Cholera, but the congestion of the lungs was extreme, and about two pints of blood gushed from the cut roots, and immediately coagulated. The fluid in the intestine is described as "a thick yellow substance."

The cramps were most common in the legs, then in the thighs, the toes, the hands, the forearms, the abdominal muscles, upper arms, shoulders, and the neck, in the order here given. They were of infinite degrees of severity.

4. *Symptoms referable to the functions of respiration and circulation.*

The distinctive features of algide Cholera—viz. the diminution of animal heat, the laborious respiration, the embarrassed heart, and the impeded circulation, were present in all the cases.

(a). *The heart's action.*—In sixty-nine fatal cases the action of the heart was found to be lessened in force at the time when the patients were first seen. The pulse was small, compressible, and generally quicker than usual ; in twenty-three patients who were seen before the occurrence of cramps it averaged 90 beats per minute ; the highest number was 132, the lowest 64 ; in seventeen of the twenty-three it was feeble ; in four

it was hardly perceptible ; in one case, half an hour after the first symptom of illness, it was small, fluttering, and not able to be counted. . In the twenty-third case it was of good strength, 70 per minute, and joined with a warm skin. In the cases seen after the cramps had come on it was smaller and less rapid. In other instances, seen before the appearance of cramps, it was more natural, but still notably diminished in strength. In addition to these sixty-nine fatal cases I have seen three or four fatal cases in which I was present from the time of the first symptom of illness, long before the accession of cramps, and even before the distinctive change in the eyes became marked, and even in these cases the pulse appeared smaller than usual, and was certainly never increased in strength and power. The conclusions arrived at from these sixty-nine cases are in accordance with all the fatal cases I have seen, and which were very numerous, although unfortunately of many of them I have no notes.

When the heart was examined, on the first investigation of the case, its action presented considerable differences. In some it was beating rapidly and tumultuously, and the sounds were confused. In one case the first sound seemed almost continuous ; in other cases, both sounds were natural in rhythm, and the period of rest was not shortened, but the sound was low : at an after period the second sound was often lost entirely, or lost and regained at intervals, and both sounds were unequal. In two or three cases, towards the end, the sounds were quite deadened by the rapidly repeated and coarse respiratory murmur. A very feeble action at an-

early period of the illness always indicated a malignant ease. The impairment of the heart's action, and the state of the pulse at the wrist, as to debility, intermission, &c. preserved a constant ratio to each other, till towards the close of the case. At this time, when the pulse was impereetible, or at times felt fluttering, and then again lost, the heart would often appear to regain, partially, its vigour, and beat less rapidly, and with greater force. This was not, however, a favourable sign; it was accompanied often by cardiae uneasiness, and occasionally by severe pain in that region, and sometimes there was conjoined a local development of heat in the chest and abdomen, while the extremities continued icy cold—a symptom always fatal, and denoting speedy dissolution.* From these circumstances, it seems to me probable that the increased action of the heart at this time may have been induced by some fresh irritation; such as the formation of clots in the cavities, or changes of a similar kind.

(b). *The respiratory movements.*—Tightness and oppression across the lower part of the thorax, and slight dyspnœa, were very usual symptoms in the sixty-nine fatal cases, when they were first seen. The dyspnœa seemed to depend on some cause which made the inspirations to be shallow and frequently

* This local development of heat was not, however, confined to cases in which there was increased action of the heart.

repeated. The average number of respirations was sometimes very great, at a comparatively early period.—A man was attacked suddenly at half-past one A.M.; at a quarter past three A.M.—that is, in one hour and three quarters—the respirations were 56 per minute. This was, however, an extreme case; the majority breathed from 20 to 28 times per minute when first seen; afterwards the respiration became more laborious in the greater number of cases, although in some few it appeared to be not more rapid than at first. In every case, however, it was shallow; even in those seen at the very commencement. At the latter end of a case, when it was most laborious, the respiration can only be described as “heaving;” it was principally costal, and the abdominal muscles fell in at the end of a full inspiration.

On listening to the respiratory murmur, it was in every case altered at the time when the distinctive features of the disease were present. I have never examined it in the very early stages. The first change I was able to note, was an evident lessening of the inspiratory murmur; then this became roughened and more bronchial in character, and the expiratory murmur was lengthened, and much more audible than usual. In one case the expiratory murmur was to the inspiratory as 5 to 12; in another, as 4 to 6; in another, it was half as long. In others it was reported merely as lengthened and audible. In several cases, muco-crepitant, mucous, or sonorous râles, were heard at times in one part or other of the chest. In several cases it was noted, that the vesicular murmur seemed, as it were,

eut short. Such were the chief phenomena in the sixty-nine fatal cases.

In a man who had been pulseless for three days, as I was informed by his medical attendant, I heard rather loud deep rhonchi during inspiration and expiration, but no vesicular murmur. In an Asiatic, admitted on the point of death, there was sonorous rhonchus on the left side, and occasionally a slight mucous râle; on the right side there was a loud mucous, or muco-crepitant râle, during *expiration*. The inspiratory murmur was bronchial, or nearly so. In another case, admitted on the point of death, the respiration was altogether costal, and very feeble; the inspiratory murmur was rough and bronchial; the expiratory was not heard.

In seven cases (Asiatics), convalescent from severe Cholera, the following symptoms, connected with the thoracic organs, were noted:—in all, the skin was still cool and the pulse very feeble; in two, the first sound of the heart was shortened in duration, and approached in character to the second sound;—in all, the sounds were feeble; in one, hardly heard. In all, the inspiratory murmur was coarse, somewhat bronchial, and quite divested of its soft vesicular character. In all, the expiratory murmur was abnormally distinct; in one, louder and harsher than the inspiratory; in another it was prolonged, but softer in character. At an after period several of these men suffered from cough. In a convalescent, with a good pulse and warm skin, the inspiratory murmur was found to retain still its bronchial character, and the expiratory murmur was unusually distinct.

(c). *Changes in the animal heat, the voice, and the colour of the surface.*—These symptoms were present in all the cases, in degrees commensurate with the lesions of the circulating and respiratory functions producing them. The first change in the colour of the surface was denoted by the eyes; when these were attentively looked at, the conjunctivæ were seen to be a little blanched; the insides of the lids were paler and drier than usual, and there was a slight tinge apparent under the eyes; the fauces, also, were cool and pale: these symptoms, in certain cases, often afforded satisfactory evidence of the nature of the case, even before the stools assumed distinctive characters. As these phenomena differed only in degree in the several cases, and as I shall have to refer to them in another chapter, I shall not enlarge upon them at present. One symptom noticed by writers I have never witnessed: it has been said that the breath could be seen issuing from the mouth of the patient. This appearance must have been produced, I presume, by the condensation of the watery vapour; and as I witnessed cholera only in hot stations, the heat of the climate prevented the manifestation of this symptom. But I think it an important observation, not only because it proves the great refrigeration of the breath, but also because it seems to indicate that the expired air, itself diminished in volume, is surcharged with watery vapour. And if there be an excess of watery vapour thrown off from the bronchial mucous membrane, this is in accordance with the general law, that there is in cholera an escape of fluid from free surfaces,

whether this be the intestines, the skin, or, as in this case, the bronchial membrane.

5. *Passage of fluid from the skin and kidneys.*

When the case first came under observation the skin was generally moist, and occasionally there was considerable sweating. Afterwards the sweats were generally exceedingly copious. This did not hold good always, for in one case the skin was dry throughout, and in several it was dry until the algide symptoms were well marked.* It appeared to me that the fluid passing by the skin was different towards the commencement and towards the end of the ease. Thus, at the time when vomiting and purging, and eramps, were present, the perspiration was often profuse and cold, and depended, it is to be presumed, on the same cause which originated the escape of fluid from the blood by the intestinal mucous membrane : but in the last stage of the disease, when the vomiting and purging had ceased, the skin was often bedewed by a thick, clammy, greasy, or oily sweat ; and as at this time the circulation was nearly arrested, and no fluid escaped from the other free surfaces, it is possible that this dense fluid escaping from the skin was the result of some chemical changes in the blood which had stagnated in the capillaries. And this view

* The profuse perspirations probably assist in the lowering in the temperature, but from the circumstance of the coldness being well marked with a dry skin, it is evident that the share they have in this effect is not very great.

is in some measure supported by the fact, that, in the most marked cases of this occurrence, there was also that local development of heat to which I have before referred, and which, as it comes on immediately before death, and even increases after death, is due, I conceive, to some chemical changes : such as some of the liquid components of the blood becoming solid. I regret that I did not examine into the nature of the perspiration as to acidity, alkalinity, or other properties.

The secretion from the kidneys is almost always suppressed during the latter period of the case. In two cases, immediately before death, I saw a small quantity of urine passed ; it was quite pale, watery, and did not possess any urinous odour. In another fatal case, a female stated that she had passed urine with her stool twice, at a time when she was deeply in the algide stage.

The period when the urinary secretion stopped could not be well determined. The majority of the patients could give no account of the circumstance : many of them stated that they had not passed urine for some time. In the cases where there had been watery purging for two, three, or even four days, urine had been passed up to the period of admission. In some of the severe cases the patients named a time for the last micturition. Thus, a soldier admitted at 6 A.M. with the algide symptoms well marked, and who had been constantly purged for five hours, said he passed urine immediately before admission. Another soldier stated that he first felt ill at 4 A.M. ; that he had one stool, and then went to parade, which in India is held soon after sunrise. Immediately after parade he had

three more stools, vomited once, and passed a small quantity of urine ; he then came immediately to hospital at half-past 8, and when admitted was deeply in the algide stage. A third soldier felt ill for the first time when he was relieved off guard at 6 A.M. He had one stool, and passed urine at the same time. At 7 A.M. he came to hospital, without having had any more purging or vomiting : the algide symptoms were well developed. These three cases were among the most rapid and malignant cases I have ever seen. A fourth soldier, admitted in an early stage, but with the algide symptoms well defined, stated that he had passed urine a few minutes before admission. A fifth soldier was purged from 11 P.M. to 6 A.M., when he was first seen and found collapsed. He said he had passed urine at 5 A.M. A sixth soldier was admitted at 20 minutes past 5 A.M., having been purged more or less all night. He passed urine at 4 A.M. Another soldier was seen at a quarter to 11 A.M. : he had been purged several times during the night, and, one or two hours before admission, had passed a large quantity of urine. In several other cases the patients stated that they had passed pale urine some indefinite time after the commencement of their illness.

6. Condition of the blood drawn during life.

In forty-one cases in male Europeans, in the epidemic attack which I witnessed in 1843, twenty-five were bled. In thirty-five male Europeans in the epidemic attack of 1845, it was deemed expedient to bleed only in a single case : this was not from any acquired dis-

trust of bleeding in the early stages and in the mild forms, but because in 1845 almost all the cases presented the malignant form, in which bleeding has never been practised with benefit. I never saw any Asiatic bled. In many of the cases bled in the later stages in 1843, the blood, dark, and apparently thickened, flowed only in drops, and it was often necessary to foment the arm to get even a few ounces. At an earlier period the blood flowed freely. In the majority of instances it coagulated immediately; in some cases it did not coagulate. I am unable to give the proportion of these cases, as I have unfortunately lost the notes which I took respecting the appearance of the blood, and have preserved merely a summary. But the clot appeared to me to be generally loose and grumous, and often did not shrink and expel serum, and this in a degree apparently corresponding to the severity and advanced stage of the disease.

I was very anxious to examine into one point in connection with the blood, which appeared to me to be of the greatest interest—I refer to the presence of urea in that fluid,—a circumstance proved by the experiments of very able observers. The urgent duties which devolve upon army surgeons during an epidemic attack of Cholera, allowed me no time to enter into this investigation. It is a point, however, which must be determined before a proper description of the latter stages can be given. Generally there is complete suppression of urine: the bladder is contracted to the utmost; and even in cases of recovery, or of consecutive fever, I have passed the catheter seventy hours after the commencement of the case, and found no urine

yct secrected. Is the urea, then, retained in the blood, or is there cessation of its formation because the processes which give rise to it are absolutely suspended?—Questions hardly to be answered until an accurate quantitative analysis of the urea in choleraic blood shall have been made. On the one hand it may be said that we have proofs that urea is in the blood, though its quantity has not yet been determined; and that there are many symptoms, such as coma, a peculiar typhoid state, &c., seen at the latter end of a case, or in the stage called consecutive fever, which seem strongly to resemble the symptoms produced by insufficient elimination of urea. Again, I have observed a practical point of some importance, viz. that the secretion of urine after the algide stage—in other words, at the commencement of consecutive fever—is so far favourable, as it is abundant in the ingredients which give its colour, odour, and specific gravity to the urine.

But, on the other hand, how can we conceive much urea to be formed when the processes of nutrition and secretion seem so completely arrested,—when there is no saliva formed, no bile passed, no evidence of true secretion, but mere passage or exhalation of some of the ingredients of the blood? In many cases we see, for hours, a man lying perfectly still; he is not restless, he has no spasms, the heart is scarcely beating, and the chemical changes connected with the processes of nutrition and secretion, which give rise to animal heat, are quite abolished. From what destruction of tissues can, in this case, the urea arise?—Nay, in such a case the impairment of the chemical changes seems almost indicated in the imperfect action

of the mind. Such a man is not somnolent; he knows all that passes around him, or can know if so he pleases; but he is indifferent and inattentive; he is slightly deaf, but he hears questions when asked in a loud voice,—it is a trouble, however, to him to answer them; a fatal lethargy, or sloth, has crept over his spirit, and a dull recklessness as to the issue of his disease has succeeded to that keen restlessness and anxiety with which he met its first and early inroads. But at this very point of time, at the last moment of life, all men have noticed with astonishment how untouched the intellect is in reality, and how undisturbed are its operations if once its strong volition can temporarily overcome what seems to be a material impediment to its exercise. In such a case, equally with one in which there is coma, profound, permanent, and even with stertorous breathing, the excretion of urine is arrested.

And with respect to cases of consecutive fever, the low congestive state, with coma, subsultus tendinum, and symptoms of a like kind, cannot be solely attributed to non-elimination of urea; because, in the first place, some urine is always passed, and occasionally its quantity is considerable; and secondly, it is necessary not to disregard other causes, such as the impaired action of the lungs or heart, which are also active in these cases. Besides, in some cases of consecutive fever, equally preceded by suppression of urine, and not relieved in any unusual degree by its excretion, there is no coma or headache, or symptoms referable to disturbance of the cerebral functions.

CHAPTER IV.

SYMPTOMS OF CHOLERA CONSIDERED COLLECTIVELY.

THE chief phenomena of cholera may be referred to three heads, viz. to the changes in the abdominal organs, in the thoracic organs, and in the muscular system. What ratio, then, do these phenomena bear to each other, and what is their reciprocal or mutual action?

It is necessary to determine what is the first and earliest symptom of cholera;—it is not cramps as a general rule, as appears from the previous chapter: is it, then, purging and vomiting, or some modification in the actions of the heart or lungs? In the sixty-nine fatal cases, which I have used as the basis of my observations, the patients did not apply for assistance until the algide symptoms had declared themselves. All that could be learnt of their history was, that they had had a certain amount of vomiting and purging, and also, if the disease had set in suddenly and violently, certain symptoms, common at the commencement of most malignant affections, such as vertigo, tinnitus aurium, muscular weakness, tremors, and partial syncope. But at the very commencement, whether any modification of the circulation and respiration existed, could not, of course, be known. That

such was the case, however, is rendered probable by the fact, that in some other cases which I witnessed at an earlier period, I was always enabled to detect the presence of such modifications when true cholera had commenced. And, moreover, in the majority of cases of Europeans included in the sixty-nine cases, the time when they were first seen was not at a very advanced period of the disease: thus if we exclude all the cases in which the patients stated that they had been purged for two, three, or four days, and which purging is to be referred to the premonitory diarrhoea, the time elapsed from the very first stool was, on an average of twenty-four cases, only six and a half hours, and yet the algide symptoms were well marked.

And here I may allude to the very insidious nature of algide Cholera; it is singular that the early steps of so rapid and violent a disease should be in many cases almost imperceptible. The Europeans referred to above, were all soldiers; strict orders were issued that at the very commencement of illness, of whatever kind, they were to report themselves sick; the non-commissioned officers of companies had orders to inspect their men continually, and immediately to send to hospital any man who appeared to have a tendency to diarrhoea. The result was, that, except in a few instances, when the attack commenced with appalling rapidity, and with marked or painful symptoms, as cramps or syncope, nearly seven hours elapsed, on an average, from the first stool before assistance was sought for. And this was not owing to any ignorance or inattention on the part of the men or of the non-commissioned

officers ; men constantly reported themselves sick on account of the most trivial complaints, under the apprehension of Cholera, but those really affected seemed to be the last to comprehend the terrible disease which was impending over them ; they could not believe that a little purging, unattended by pain, and apparently similar to attacks they might have suffered from before, could be followed by consequences so grave, and results so fatal. And I believe that my experience on this point is in accordance with that of military surgeons in general, who know how difficult it is to meet with a case of Cholera in its earliest stage unless it be detected by themselves, or be attended, as in the minority of cases, by early-marked and alarming symptoms. With the Asiatics it was somewhat different ; they were better acquainted than the Europeans with the early symptoms of their "jurree màrhi," or "rapid death," but still, either incredulous in the power of medicine, or resigned to the decrees of an inexorable fate, they were seldom admitted into hospital until the case was well marked and defined. These considerations will account for the want of evidence afforded by the fatal cases on this particular point.

Although I consider it probable, therefore, from the degree of the algide symptoms at the period of admission, and from the cases which I witnessed from the commencement, that some lesions in the actions of the lungs and heart might have been detected by an experienced eye, some time before the patients reported themselves sick, yet my cases do not enable me speak with perfect confidence on this point.

It follows, therefore, that my cases do not enable me to decide as to the period when Cholera could be said to commence in these cases. Was it from the period of the first stool—some six, twelve, or even twenty-four hours before? Or, up to a certain point, was the case one simply of premonitory diarrhoea? In many cases certainly the diarrhoea was only premonitory; thus, when it had lasted for three or four days unattended by algide symptoms, it was clearly only similar to those cases of diarrhoea constantly witnessed during the epidemic constitution, but which, from some more fortunate circumstances, are arrested before they merge into the fully developed disease.

But, whatever be the relations of the purging and vomiting to the algide symptoms at the very commencement—whether the former precede the latter symptoms, and if so, to what extent—is of little consequence compared to the next question, as to their connection during the whole course of the disease. And I believe this question can be answered with great certainty. My cases bear out the observations of Scot, Jameson, Orton, Kennedy, Copland, and, in fact, almost all the English writers of reputation *, that there is absolutely no ratio between these two classes

* Many of the French writers in 1830-32 attributed more influence to the intestinal effusion, which was fully recognized as part of the blood, than the English writers of that time. This was the case with Broussais and his numerous followers, as might have been anticipated; also by Gendrin, Bouillaud, Moreau de Jonnès, and other authors of equal note.

of symptoms ; or that they appear even to observe an inverse ratio to each other. Thus at a period of the case when the algide symptoms were most fully developed, viz. in the last five hours, the purging ceased ; in the eases where the algide symptoms were prominent throughout, and which eases were consequently the most malignant and the most rapidly fatal, the passage of fluid from the intestines was oftentimes trivial in degree, and shortened in the period of its occurrence. In cases in which the vomiting and purging were excessive, the algide symptoms often came on slowly, and were less marked and deadly.

Thus an European soldier stated that he had been purged for two days : after admission he had twelve more stools, many of them very copious, yet he lived for thirty-six hours, and cramps had eased for nineteen hours before death. Another soldier had been purged for four days ; he had two stools after admission, and lived for ten hours. A third had been purged for four days, and after admission had five more stools ; he lived for nineteen hours. A fourth soldier was purged fifty times altogether, and lived seventeen hours from the time of the first stool. A fifth soldier was purged many times before admission, and ten afterwards ; he lived for thirty-eight hours after the first stool, and twenty-eight after admission into hospital.

As a contrast to these eases I will cite the following. An English soldier had five stools before admission, and seven scanty ones afterwards ; he lived nine hours from the time of the first stool, and five hours after admission. A second had four stools before admission, and

one or two afterwards ; he lived five hours from the time of the first stool, and four hours after admission. A third soldier had four stools before admission, and one afterwards ; he was ill six and a half hours altogether, and lived four and a half hours after admission. A fourth had two stools during the whole course of his illness ; the first one he stated to have been copious, the last was about one pint in quantity ; the duration of the disease was eight hours, and he was seven hours in hospital. In all these cases the vomiting was trifling, and the escape of fluid from the skin not conspicuously greater than in other cases.

In Asiatics the same observation held good. A Hindoo lived one hundred and eight hours from the time of the first stool, and ninety-one after the positive development of algide symptoms ; he had altogether twenty-two stools. A Burman lived seventy hours from the period of the first stool, and fifty-one after algide symptoms : he had twenty-six stools altogether. A Bengalee lived fifty-three hours from the period of first attack ; when admitted into hospital he was deeply collapsed, but lived for thirty-one hours : nine stools were counted, and, in addition, he passed in bed many watery and serous stools, which could not be counted. In opposition to these cases, let me cite that of a Bengalee, a very muscular man, 5 ft. 11 in. in height—not an opium, nor bhang eater, nor intemperate—who had only four stools, and died in ten hours after the first of these, and four and a half after being seen by a medical man. A Burman, who was much addicted to opium-smoking, had eight stools, and

lived twenty-one hours, or eleven after being first seen. A very stout muscular Burman had five stools before admission into hospital, and four afterwards; he lived twelve hours from the time of the first stool, and eight after admission.

It may be objected to observations of this kind, that the number of stools is, after all, no certain indication of the amount of fluid passed: this objection would be of weight in cases where the stools were not very different in number; but, in some of those cited above, we have two or four stools attended by a more rapid death than twenty-five or twenty stools, and yet in the first case, it would be impossible not to suppose the quantity of the fluid passed, to be much below that of the second case.

Another objection is, that it cannot be known how many of the stools are to be included in the term of the disease, and not in its premonitory stage.

Perhaps here an appeal to general experience is of more weight than a reference to numbers, and it may be confidently asserted that there is no one who has seen much of cholera who does not know that, exclusive of the mildest forms of the disease, a case with little vomiting and purging is more malignant, and more rapidly fatal, than one in which these are prominent symptoms.

But in order to illustrate this point as fully as I can from my own experience, I shall detail three cases of recovery during a severe epidemic attack, in which there was as much, if not more purging and vomiting, than in the majority of the fatal cases. And I am

desirous of detailing these cases for another reason, namely, that, though undoubtedly cases of true cholera, they seemed to recover without passing through any declared and prominent stage of consecutive fever.

W. S., an English soldier, æt. 25, admitted 5 A. M. August 27th, 1845, states that he felt unwell yesterday morning for the first time; he was thirsty, and felt sick at intervals during the day, but did not vomit. At 4 P. M. he had a very copious watery stool, and soon after this felt deaf, giddy, and weak, had ringing in the ears, and felt exceedingly short of breath; to use his own words, "he felt as if he could get no air, and would be stifled." He took two drachms of arrack, and went to sleep; while sleeping he had a very copious involuntary motion, and from that time to the period of admission he had a great number of stools, which he says were like "pure water;" he vomited twice during the night, and passed urine three or four times. When admitted, the skin and tongue were warm; the eyes sunken, and with dark areolæ; the voice altered, raised, and cracked; the breath short, and respiration slightly laborious; there was nausea, and soon afterwards he had a loose stool.

6 A.M.—One stool; great vertigo,

Half-past 6 A.M.—Vomited a large quantity of greenish fluid, which seemed to relieve the vertigo; one stool.

Quarter-past 7 A.M.—Violent cramps in the lower extremities have come on for the first time; nausea; no vomiting. At this time he commenced $3\frac{1}{2}$ grs. of acetate of lead, with $\frac{1}{2}$ gr. of opium every half hour, or hour, according to circumstances.

Half-past 7 A.M.—A scanty stool, with white flocculi; vomiting of a watery fluid; skin and tongue still warm; voice raised in note, and cracked; eyes sunken, lips slightly livid; great thirst; all the early feelings of vertigo, tinnitus aurium, &c., have gone off.

Five minutes past 8 A.M.—Transient cramps in left leg; relieved by friction; pill taken and retained.

Twelve minutes past 8.—Another scanty flocculent stool; the clear fluid separated from the flocculi did not coagulate when boiled, and gave no precipitate with nitrate of silver.

Half-past 8 A.M.—Three scanty stools, with white flocculi; pulse 60, and very small; skin becoming cold; eyes red; feels a weight and burning at the epigastrium; tongue white and cold; voice much lower, and totally altered in tone since last report; transient cramps in the legs every now and then; says that he passed urine with his last stool. Pill taken and retained.

9 A.M.—Pill taken and retained.

Half-past 9 A.M.—Pill taken and retained.

10 A.M.—Has had three scanty serous stools; vomited twice; pill taken and retained.

11 A.M.—Another scanty stool; feels a great oppression across thorax; voice low, yet shrill in tone; transient cramps now and then in the toes; tongue cool, not cold; breath warm; pulse small, regular, 80; eyes much sunken, with livid areolæ; face and lips dark; hands dark, and a little shrivelled; vessels of conjunctivæ enlarged; respiratory murmur shortened; expiratory murmur not heard; heart's sound feeble, but normal in rhythm; respirations costal and quickened; one stool,

3vj. in quantity, watery, with white flocculi, and a caseous smell. Pill taken and retained.

12 M.—Three scanty congee stools; cramps in toes. Pill taken and retained.

2 P.M.—Has taken four more pills, and has had several scanty stools; vomited a large quantity of greenish fluid; hands cold and shrivelled; pulse very feeble.

3 P.M.—Two congee-water stools; cramps in calves of legs. Pill taken and retained.

4 P. M.—One stool; vomited twice. Pill repeated and retained.

5 P. M.—One scanty stool; great thirst. Pill retained.

6 P. M.—No vomiting, purging, or cramps, since last report: is lying quiet.

9 P. M.—Has continued the pills regularly, and has retained them; has been several times on the close-stool, but has passed nothing.

10 P. M.—Is asleep; no vomiting or purging since last report.

12 midnight.—Has just wakened up, and had a scanty stool.

6 A. M., August 28th.—Has been asleep nearly the whole time since last report.

Half-past 7 A. M.—Is now awake; skin warm, pulse full, and rather bounding; voice better, though not yet natural; eyes less sunken; face more filled out; no stool since midnight; breathes easily and tranquilly; says he wishes to pass urine, but cannot do so.

Omit medicines. Warm fomentations to the abdomen.

Half-past 10 A. M.—No stool or emesis since last report ; says he feels quite easy ; skin warm ; pulse good ; face regaining the natural appearance ; has passed no urine ; the catheter was passed, and 12 ozs. of pale yellow, perfectly transparent urine, with a slightly urinous smell, drawn off ; nitric acid added to the urine gave a brownish red colour, but no precipitate.

Meridie.—Has been sleeping quietly ; pulse rather quick ; skin warm.

6 P. M.—Has passed urine freely.

August 29, 6 A. M.—Is not so well ; has had several stools during the night, and some vomiting, and thirst. The irritability of the stomach has been checked by effervescing draughts.

Half-past 8 A. M.—Three dark-coloured liquid stools with faeculent matter ; passes urine freely ; no vomiting since last report. Port wine $\frac{3}{ii}$.

Vespere.—Has had eight darkish liquid motions during the day ; some vomiting ; skin warm ; pulse good, but not quick or strong ; is restless and thirsty ; no hiccup. Three grains of Acetate of Lead were given every second hour during the night.

6 A. M., August 30.—Better ; only three stools during the night ; no vomiting ; has passed urine. The pills were continued till the following day, when all the bad symptoms having disappeared, they were omitted.

He seemed weak and reduced by the attack, but had no fever, cough, or prominent symptom of any kind, and four days afterwards left the hospital perfectly well.

This patient, then, had great purging before he entered the hospital; after admission thirty-four stools were counted, and in addition, at two periods he had "several stools," but the report does not give the number. Eight attacks of vomiting are noted, and these were not the whole number. It is true that the stools are often called scanty, but the term is often used in the reports of the most malignant cases.

Thus we see an immense passage of fluid attended by very moderate, almost trifling algide symptoms, comparatively speaking, and followed by a complete and rapid recovery without marked or consecutive fever.

The next case is not so striking, but resembles the former in not being followed by fever.

W. R., an English soldier, æt. 25. Admitted 8 A. M., August 27, 1845. Was in perfect health till 12 o'clock last night, at which time he felt inclined to be purged; he went to the rear, and stopped there for two hours, being purged almost constantly; the stools were watery, and ran from him without any pain. He felt sick, giddy, and faint, but not in any great degree; he had no deafness or noise in the ears. When asked to name the number of stools, he says more than twenty.

Half-past 8 A. M.—Three stools in last half hour; spasms across the abdomen have just come on; no cramps in the legs; nausea, and attempts at vomiting; skin and tongue cool; pulse 80, small, compressible; eyes sunken; dark circle round them; voice slightly altered; says he passed urine two hours ago. Four

grains of acetate of lead and half a grain of opium every half hour.

3 P. M.—He remained quiet till 3 o'clock. At this time he had had three more stools, but the algide symptoms were going off. The skin was warm, and the pulse fuller.

Vespere.—No more purging; skin hot; pulse full, hard, and bounding; says he feels quite well.

August 28, 6 A. M.—Pulse, skin, and countenance natural; ordered to get up.

29th. —Discharged perfectly well.

In this instance, a man enters hospital after having had more than twenty stools, in all probability very copious ones: during the whole course of his illness he has six more, making a much greater number than the average of the fatal cases, and yet he has the algide symptoms so slightly marked, as only just to bring him within the list of cases of true Cholera.

The next case was better marked.

C. K., English soldier, æt. 26. Admitted half-past 4 P.M. August 16, 1845.

Quite well till this morning, at 4 A.M. At that time he was attacked suddenly with profuse watery purging; no vomiting: he felt rather faint; after an hour or two he felt better, and the purging diminished. The bowels continued to be rather loose till 2 P.M., when he suddenly became again attacked, and, since then, he has been purged a great many times, so often that he cannot tell the exact number; he passed urine as freely as usual at 4 P.M.

At present.—Surface and tongue cool; hands cold;

eyes slightly sunken, and areolæ livid ; lips slightly livid ; voice a little raised in note ; no tightness across the chest ; no dyspnœa ; pulse small, 120 both in the erect and in the recumbent position ; no vomiting or cramps.

He commenced acetate of lead four grains, and opium half a grain, every half hour.

6 P.M.—Very severe cramps in both legs during the last half hour : no vomiting or purging ; urgent thirst ; skin warmer.

Half-past 7 P.M.—Slight cramps ; skin warmer ; pulse only 84.

Half-past 9 P.M.—No cramps since last report ; pulse fuller ; tongue warmer.

10 P.M.—One very copious, watery brown-coloured stool : has just passed a large quantity of perfectly pale watery urine.

Half-past 11. P.M.—One watery flocculent stool.

3 A.M. August 17th.—No purging or cramps ; feels inclined to sleep.

8 A.M.—Skin warm ; pulse natural in strength and frequency ; tongue warm ; countenance natural ; says he feels quite well.

All medicines were omitted ; but, on the subsequent night, he had a return of the watery purging without cramps : the acetate of lead was again given, and the next day he appeared perfectly well in all respects.

He was discharged August 22nd.

A case somewhat similar to these occurred at the same time, in a stout Irishwoman, æt. 33. She was

purged eight times before admission, and so many times afterwards that the stools could not be counted. She also vomited continually, and the quantity on several occasions exceeded a pint. The cramps were very severe and long continued; yet the algide symptoms were comparatively slight, although developed in an early stage, and she recovered without any consecutive fever.

I have notes of a few other cases in which the patients recovered without any appreciable fever, but as these were not remarkable for any great amount of purging or vomiting, I shall not occupy space by inserting them.

It appears to me that these cases fully bear out the inferences drawn from the amount of purging in the fatal cases, and warrant the assertion that the quantity of fluid passed from the alimentary canal was in no degree commensurate or proportioned to the malignancy of the case. May not, however, the fluid poured into the canal, but not ejected, have borne some relation to the severity of the disease? To this a partial reply only can be given: certainly, after death in malignant cases, there appeared to be a considerable quantity of the thick clotted fluid in the canal; it was almost impossible to measure this, but, judging by the eye, it seemed to vary, like the stools, without much reference to the severity of the case, and to be small in quantity in some of the most rapid cases, attended with little purging.

What relation, then, did the passage of fluid into the alimentary canal, on the one hand, or the algide

symptoms on the other, bear to the other symptom, viz. the muscular contractions? The question is easily answered in respect of the algide symptoms, as, when these were at their point of greatest intensity, the cramps ceased, and it was also a matter of familiar observation, that, in the worst and most rapid cases, there were hardly any spasms.

The relation between the vomiting, purging, and cramps, appeared to be more intimate. The average period of cessation was in each case nearly the same, and there was throughout the whole of the disease a general accordance in the prevalence of the two symptoms. In many cases the cramps were observed completely to ally themselves with the purging; to manifest themselves at intervals corresponding to the stools; to cease, and again to recur as the stools ceased and recurred; and finally to disappear altogether when the purging was arrested. But it was also equally certain that the cramps never shewed themselves *pari passu* with the purging from its first commencement; they appeared hours after the first stool, and often only when the algide symptoms were well marked; it was also certain that they were very severe in some cases with little purging. How are these contradictions to be reconciled? The explanation is perhaps to be found by referring to the nature of the stool: in the earlier periods of the case the stools were more watery, copious, and free from white flocculi; in the after periods they were less copious, and white flocculi were abundantly present: it was in this after period that cramps became common. This coincidence of prevalence does not

necessarily imply connection, but an additional argument is furnished by the fact that the greater or less prevalence of cramps did seem to bear a constant ratio to the white flocculi in the stools, and to the curdy substance found in the canal after death. Thus, in the cases where the purging was great, and the cramps severe, white flocculi were abundant ; where the purging was trivial, but the cramps severe, the stools were often milky, or chalk-coloured, from the abundance of the thick proteine constituents ; when there were no stools, but severe cramps, the white matter was contained in large quantity in the intestine, and finally, in those worst cases, in which there were few stools and only trifling cramps, the quantity of this white matter in the canal, judging from the eye, appeared to be less, although certainly it was always present to some extent. That there is something more in this than mere accidental coincidence appears to be very probable, and if so, there would be no doubt that the cramps in cholera are merely reflex spasms, produced by the action of an unusual fluid or substance in the intestinal canal. It may be urged as an objection that there is a class of cases, to which I have already referred as premonitory of true Cholera, where, with a warm skin, and a rapid and bounding pulse, a copious purging of a clear fluid with few white flocculi, or, indeed, entirely free from them, is attended with severe and general spasms. But in these cases the spasms seem to be of a different kind ; they are more general at the commencement than the cramps in Cholera, and involve a greater number of muscles ; they appear more like convulsions or tetanus ; they last a shorter

time, and present many little distinctions not easy to be described, but which are very readily noted when a case of this kind is compared with one of the algide Cholera lying in an adjoining bed. In these cases, with a warm skin and good pulse, it appears as if a deluge of fluid, no doubt intensely irritating, if we judge from the violence with which it is expelled, is thrown into the canal ; the canal is distended, and general excito-motory spasms are produced.

In addition to the quality of the fluid causing spasms, it is very possible that its quantity may have no unimportant influence in the matter. Thus it was often seen that after a stool a patient would remain quiet and painless for some time, cramps would then slowly return, and gradually increase in severity ; another stool would then be passed, and the cramps would again temporarily cease : now in this case it seemed as if, after the expulsion of the fluid, there was again a gradual re-accumulation in the intestines ; when it reached a certain point cramps commenced and increased, while the effusion still went on ; when the fluid was again removed, the cramps again ceased. And, in accordance with this fact, I have noticed in several cases that the administration of medicines, or of fluids to drink, when taken in a large quantity, and more particularly of large injections, sometimes caused a return of the cramps after they had appeared to have altogether ceased.

Only three possible explanations of the cramps occur to me : either they are reflex spasms produced by the

effusion into the canal, or they are produced by the altered blood present in the algide stage, or they are results of the cause acting in some mysterious and occult way on the nervous system. The second supposition is, I conceive, at variance with the facts, which shew no relation in intensity between the two sets of symptoms ; the third opinion is altogether gratuitous and unsupported by evidence, and it is therefore almost a matter of necessity to admit the first explanation as being the most plausible and probable, although it has certainly not been completely and satisfactorily proved.

If, therefore, the cramps are to be referred to the passage of fluid into the intestinal canal, we have in Cholera only two sets of symptoms to consider : first, the group derived from the lesions of the circulation and respiration, and which, for the sake of distinction, has been called the algide group ; and secondly, the abdominal symptoms of vomiting, purging, and the dependent spasms. These two groups are, however, in an inverse ratio to each other in point of prevalence. The one does not induce the other ; they are independent effects of the common cause. But the algide symptoms are in fact the disease ; in proportion to them is the malignity and the rapidity of the case ; they afford the only measure of its severity, and from them only can a correct prognosis be formed. Whence it follows, that the vomiting, purging, and cramps must be considered merely as usual but non-essential symptoms of Cholera, whose absence would not in the least affect the diagnosis of the disease, and

that consequently it is within the bounds of possibility or even probability, that cases of Cholera may occur entirely divested of these symptoms.

I need scarcely remark that several cases of this kind are upon record, and, although I have never myself witnessed these extreme instances, it is satisfactory that, from reasoning on my own fatal cases, in every one of which purging was present at some period of the case, I have come to a conclusion identical with that derived from actual observation, by several of the most eminent writers on this subject.

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CHAPTER V.

GENERAL DESCRIPTION OF THE SYMPTOMS OF CHOLERA.

THE chapters on the symptoms considered separately and collectively, would be incomplete if they were not succeeded by a general summary of the course and progress of the symptoms. In drawing this up I have confined myself as much as possible to the symptoms presented by the fatal cases, or by cases of recovery thoroughly marked by the algide stage. By adopting this course, all those pseudo cases of Cholera, seen after or during the prevalence of an epidemic, and which constitute the majority of cases reported as cured, are excluded from consideration, or are referred to the premonitory stage. That these pseudo or sporadic cases are allied to Cholera algida, and often pass into it, cannot be doubted : the nature of their relation will be briefly considered in a subsequent chapter.

If all these anomalous and obscure cases are excluded, we isolate a disease which presents the feature characteristic of all the affections consequent on the action of morbid poisons ; it has a definite course and termination ; when the undoubted symptoms of Cholera are present, it cannot be cut short ; it must pass on to the development of the symptoms, although of course these may be slight or severe according to circumstances. This period of evolution, if so may be termed the time

occupied by the symptoms following the incubation of the poison, is limited ; it is followed in most cases by a febrile state, which seems only to be the reaction of the system after a severe impression, and not to be a stage of the disease, only occasionally seen on account of the initiatory stage so often destroying life. But this important question of the nature of the consecutive fever must receive a fuller discussion hereafter.

The earliest symptoms of a case of Cholera appear to be merely premonitory, and after their occurrence health may be regained without any subsequent symptoms ; this is often seen during an epidemic, when many persons suffer from the precursory symptoms, to which the developed stage never succeeds. The premonitory symptoms are diarrhoea, usually of watery stools, colicky pains, trembling, dizziness, tinnitus aurium, perhaps syncope, slight deafness, nausea, a small quick pulse, and a cool pale tongue ; in many cases there is some acceleration of the breathing, and a sensation of tightness across the lower part of the chest, and a burning sensation at the epigastrium.

At other times the premonitory symptoms consist of violent vomiting and watery purging, suddenly arising and attended by cramps and abdominal pain, and by a copious secretion of pale urine, with a warm skin and tongue, and perhaps even a rapid and tolerably full pulse. These are the cases constantly returned as true Cholera, and form many of the cases considered to be cut short by treatment. It appears probable that these pseudo cases were unusually numerous in some of the early epidemics in India, and gave rise to mistakes con-

cerning the efficacy of certain modes of treatment. There is no doubt that they are highly dangerous, from their tendency to pass into true Cholera.

These symptoms last for a variable length of time, and then, as the circulation gradually and slowly diminishes, the distinctive symptoms of Cholera algida come on ; or if the choleraic agent be present in great intensity, they present themselves without premonitory signs. After these symptoms have shewn themselves, the disease invariably runs a certain course, no matter what its degree of severity may be.

The distinctive symptoms are produced by the state of the respiratory and circulating systems. The animal heat is diminished ; this is best shewn by the tongue, which is cool or cold, and pale, and by the lips, which are slightly discoloured internally ; a slight tinge appears under the eyes, and there is a peculiar anxious expression of countenance. Such is the “Cholera visage” at the very commencement of the case. The skin is cool, and there may be slight lividity at the roots of the nails ; there are cold sweats ; pale urine is passed in a small number of cases ; generally this secretion is throughout suppressed ; the pulse is small, weak, and perhaps quicker than usual ; there is generally a strange dizziness in the head, deafness, tinnitus aurium, particularly on movement, dimness of sight, and a remarkable weakness, which causes the walk to be feeble and tottering, and induces syncope. There is often a burning heat at the epigastrium, and generally nausea, and perhaps vomiting of a greyish or yellowish watery fluid ; there is thirst, particularly for cold water, for

spirits and water, or for acid drinks. Except in the most rapid cases, there is more or less purging of a watery fluid, with or without white flocculi. Cramps either come on now or in an hour or two, according to the amount and kind of purging. On listening to the respiration it is found that the inspiratory murmur is as it were cut short ; it is rougher and more bronchial than usual ; sometimes the expiratory murmur is unusually distinct and lengthened. In direct ratio to the state of the respiration is the voice ; this is at first husky, as if there were a collection of mucus in the throat, or the note is raised ; then it is gradually lessened, and altered in tone and volume until it is reduced to a whisper. The expired air is colder than the breath of the observer. The action of the heart is weak, and, in malignant cases, the impulse is very feeble. The sounds of the heart are generally natural ; sometimes they are confused, succeeding each other rapidly, and shortening the interval of rest ; sometimes the first is like the second sound ; occasionally the second sound is lost. If recovery take place from this state the vomiting and purging gradually cease, but the skin does not for some time regain its warmth, nor the pulse its volume ; the patient lies quiet, or is drowsy, and sleeps at intervals, being awakened only by the sensation of thirst, or by an occasional and infrequent attack of vomiting or purging. After a variable number of hours, sometimes as many as sixty, the pulse is found to have gradually risen, and to beat with considerable force, the skin becomes hot, there is sometimes headache, and a febrile exacerbation occurs like

the exacerbations of bilious remittent fever. After a short space of time this goes off, and in two or three days the patient is quite well.

In the majority of cases, however, the distinctive symptoms, instead of remaining stationary, gradually become more intense; the heart's action becomes weaker, the skin and tongue colder, and the profuse sweats cold and clammy. The livid circle round the eyes enlarges, the face falls in, the eyes are sunk in the sockets, the external veins about the head and temples appear in some cases distended, the conjunctivæ are glazed and reddened, and perhaps covered with a film; the lips are livid or black; the countenance assumes, in consequence, a peculiar and terrible appearance; the skin has a dark red or bluish tinge, sometimes resembling those of a drowned person; the voice is whispering, there is raving thirst, the inspirations per minute are gradually augmented in number to 30, 40, or even 60; the pulse becomes gradually weaker, and at times intermittent; the hands and feet are shrivelled and sodden, the vomiting and purging gradually cease, or in a few cases continue in a slight degree till death. There is restlessness, apparently from the dyspnœa, which is often most distressing. In malignant cases there are, from time to time, attacks of pain in the cardiac region, as if the heart were affected with spasm; there is often pain in the loins, and in these cases, after death, the colon is found contracted; there is a peculiar odour exhaled from the body, which it is impossible to describe, but which resembles the albuminous odour of the stools: in a few cases, in fair-

haired and fair-skinned people, I have seen a white papular appearance, produced apparently by the shrinking of the skin. At a period later than this, the circulation, which has been gradually lessening from the very commencement, becomes almost altogether arrested; the pulse becomes imperceptible, or at times felt fluttering, and then again lost; the heart's action can usually be felt, or seen sometimes when its impulse is too feeble to be perceived by touch; vomiting, purging, and cramps usually cease, or sometimes recur in a slight degree. Pain in the loins is common, and sometimes there is an agonizing tightness and oppression in the cardiac region. The patient lies quiet, or is comatose, rousing himself, perhaps, when spoken to, or else roused only by transient cramps, or the sensation of thirst; the extremities are icy-cold, and bedewed by a very cold clammy or oily perspiration. If the coma be great, the breathing seems carried on entirely by reflex action, and is almost stertorous, and the patient cannot swallow, unless the fluid be conveyed beyond the arch of the fauces. If the circulation be less completely arrested, there is great restlessness, on account of the dyspncea. Sometimes the patient dies suddenly in momentary convulsions: the cause of this is not very obvious.

Two or three hours before death there is often some return of heat in the scalp and forehead, over the region of the heart or whole chest, and it may be also over the abdomen; the extremities are still icy-cold, and the Cholera visage is unaltered. This partial return of heat on the head and trunk is an immediate

forerunner of death, and, as far as I have seen, is invariably a fatal sign ; it is occasionally confined altogether to the cardiac region, and is sometimes astonishingly great. This local heat also occasionally comes on or increases after death, and is therefore owing, perhaps, to some chemical change in the blood ; it may be to some loss of solubility of certain liquid components.

The above symptoms, thus briefly detailed, might be described in another way as essential and as dependent. The algide symptoms are essential ; the abdominal symptoms dependent,—because, although they are both produced by the same cause, and in this sense are both primary, yet one is manifested only during a particular condition of the other. Thus the vomiting and purging, and, in a lesser degree, the cramps, maintain an exact ratio to the amount of the circulation ; in the cases in which this continues comparatively unimpeded, the passage of fluid is greatest. This is witnessed in cases of recovery, or in cases with a prolonged and mild algide stage, when the purging continues almost till death ; in severer cases the purging is arrested at an earlier period, coincidently with the arrested flow of blood : in the worst cases there is little or no passage of fluid, for there is little or no circulation. But this description, although I believe the correct one, would have led me into discussions which will be better considered hereafter.

CHAPTER VI.

CONNECTION BETWEEN THE SYMPTOMS AND POST-MORTEM APPEARANCES, AND HYPOTHETICAL ARRANGEMENT OF THE PHENOMENA.

A REVIEW of the post-mortem appearances confirms in a very striking manner the view taken of the symptoms of Cholera in the previous chapters. The intestines presented no peculiar appearances : sonic cnlagement of the agminated and solitary glands ; some ramiform congestion in the ilium ; an inconstant vermillion flush on the peritoneal surface,—were surely conditions too insignificant to explain the phenomena of Cholera. The liver was natural in the majority of cases ; the bile secreted before the attack, or during its early stages, was retained ; the spleen presented no constant appearance ; and, in fact, the appearances in the abdominal organs were variable and irregular.

Far more constant were the post-mortem marks in the heart, lungs, and blood. In the heart the most usual appearances were, contraction of the left, and dilatation of the right side, with accumulation of blood there, and in the pulmonary arteries. In the lungs there was a remarkable want of air : in the most rapid cases a want also of blood in the minute texture, causing the lung to collapse when the chest was opened, and its weight to be diminished in a very great degree.

In the blood there was a separation of the fibrine more or less complete in the heart and great vessels; a probable diminution in the quantity of this eomponent, judging from the oeeasional ineoagulability of the blood, and from the aeeumulation of a proteine compound eonsisting partly, at any rate, of fibrine, in the alimentary eanal; and an oceasional want of the salts. The most striking ehanges were decidedly in the fibrine, and perhaps in the albumen; the red particles appeared less altered.

The eonditions of the heart and lungs seem to point out unequivocally that in Cholera the blood does not pass through the lungs; and this agrees with the independent inferencee drawn from the symptoms, that the essential signs of loss of animal heat, embarrassment of the respiration, and gradual arrest of circulation, are produeed by some aberration of, or impediment to, the proper respiratory ehanges.

There is, then, an approaeh to the phenomena of asphyxia, but merely an approaeh without an identifica-
tion. Asphyxia, according to the received acceptation
of the term, appears to me to be distinguished both by
differenees in its causes and in its post-mortem signs.
Thus, the active eause is the absence of a respirable
gas; whereas in Cholera the fault is in some eondition
which prevents the blood from submitting itself to the
action of the air, or from undergoing changes giving
rise to animal heat, if in part it is so submitted. The
post-mortem signs of asphyxia also universally inelude
gorged and congested lungs; whereas in Cholera,
though this may occasionally happen, yet in some of

the worst cases there is a singular deficiency of blood in the pulmonary texture.*

To recapitulate here for the sake of perfect clearness : the essential symptoms of the algide Cholera, viz. the loss of animal heat,—the loss of the voice, proceeding from the diminished volume of air in the lungs,—the colour of the surface, and the arrest of the circulation, coupled with the collapsed state of the lungs after death, their deficiency in blood (although blood may be in the large vessels, and frothy serum in the pulmonary texture and bronchial tubes),—the contraction of the left cavities of the heart, with the empty arterial system,—the dilatation of the right cavities, with the distended venous system,—prove satisfactorily, as it appears to me, that there is a failure more or less complete in the transmission of the blood through the lungs. In what, then, consists this failure? Does the heart refuse to propel the blood? or does the lung shrink in some inexplicable way, and refuse to admit it? Are the respiratory muscles deprived of the nervous influence which excites them to action? or does some impediment prevent the air from entering into the chest? Or, if none of these causes are in action, can any other be suggested which shall accord with the phenomena? A moment's consideration will shew that these alleged causes are insufficient. The heart in many cases contracts naturally : it can be heard often till the very last; and the left ventricle after

* I have, therefore, not used the term "Cholera Asphyxia," which was employed by Scot, Bell, and others, because I think that some other name than asphyxia should be applied to this variety of suffocation.

death is often found so firmly contracted, that it must have closed forcibly on the last drops of blood that entered it. In those cases of coma in which the respiratory movements seem carried on by reflex action at long intervals, the comparatively speaking unimpaired action of the heart is very striking. If in some cases, however, the heart seems to fail, and is in some post-mortem examinations found flaccid in all its cavities, these are only the exceptions : they prove that failure in the heart's action may occur as an epiphomenon ; but their only occasional occurrence also proves the existence of some other condition which arrests the circulation independent of the heart. Is this condition to be found in any peculiar shrinking, or, on the contrary, paralysis of the lung ? The feelings of dyspnoea, of dragging, or tightness at the lower part of the thorax, and the collapsed state of the lungs after death, seem to give some plausibility to such a notion. But then, what is the nature of this pulmonary change ? The lung, after death, can be inflated readily ; nay, it can be voluntarily filled with air during life ; and, therefore, if its non-expansion were the true origin of Cholera, it could be readily cured by artificial inflation. But inflation is of no service, and this because the shrinking of the lung is a consequence, not a cause, secondary to the other more important changes, and not itself productive of them. The respiratory muscles are in no way paralysed, or removed from voluntary command, except in comatose cases, which form only a minority, nor is there an impediment in any of the passages to the free entrance of air. Almost till the last moment, the patient can breathe deeply, if told to do so ;

and constantly, when a deep breath is drawn, on account of severe spasm, the patient is found for a brief moment to have recovered the full tone and volume of his voice.

As, therefore, the mechanical part of respiration is perfect, and as there is no impairment in the voluntary command of the respiratory muscles, and as the heart evidently beats in many cases till stopped by the want of blood on the left side, and by its accumulation on the right side, we are compelled to look for the cause of such arrest of the circulation, in the only remaining element of respiration, namely, in the blood itself.

So far the induction appears to me authorized and legitimate ; beyond this it is doubtful and obscure. When we inquire into these reputed changes in the blood, we find an absolute necessity for a complete and thorough chemical examination of this fluid—an examination which perhaps is not to be looked for in the present state of organic chemistry ; for in spite of the rapid development of this science, by which many most important facts have already been obtained, the analysis of the animal fluids, and particularly of the blood, is yet confessedly imperfect. Whatever ingredient in the blood may, in the first instance, be deficient in Cholera, or whatever link of combination may have been displaced, it is impossible at present even to guess ; we see apparently a rapid separation of the blood into its elements,—water, salts, fibrine, and, in some cases, albumen escape, while circulation still goes on, by the ready outlets of the alimentary mucous membrane and the skin ; or they are effused into closed cavities, or into the loose texture of the lungs ; these processes occur not apparently as secretions but as exhalations ;

that is to say, the exuded fluids of the blood are not subjected to the vital influences of cells ; true secretion seems arrested ; no urine is formed, no saliva, and no tears ; the bile and pancreatic juice are not voided, and probably are not formed. With these changes muscular contractility is unimpaired ; the nervous system is often till death free from derangement ; there are no lesions of sensation,* and, beyond the cramps, no lesions of motion ; there are merely the vertigo, tinnitus aurium, and feelings of anxiety attending the early stages of this disease as of several others, and produced, it may be, by the first passage of the altered blood through the encephalic vessels.

In continuing the discussion of this question, it is impossible to avoid speculation and conjecture, while our knowledge is so limited and imperfect. But speculation, when recognised as such, seems to me essential to the progress of inquiry ; we constantly inquire what *may be*, when we are yet unable to satisfy ourselves what really *is*. And all that is necessary is to keep up the broad line of demarcation between the observed and the inferred, and not to allow previous inferences to bias future observations. With this proviso, while I venture on an hypothetical arrangement of the phenomena, and on a speculation as to the first effects of the active cause, I do not think I can incur the charge of deviating from the strict path of observation and induction.

I shall not hesitate to recapitulate and repeat some

* The dimness of sight and the dulness of hearing cannot be considered lesions of sensation : the nerves are not here primarily in fault, it is the whole apparatus which is disordered, on account of the state of the circulation.

of the conclusions previously stated, when I find it conducive to the clearness and precision of the argument.

The separation of the blood into its elements is, as I have intimated, evidently not altogether and solely represented by the passage of fluid from the alimentary mucous membrane and from the skin. The following considerations prove this :—

1. There is a class of cases exhibiting the symptoms of true Cholera in their greatest intensity, in which there is no vomiting and purging, and, till the end of the case, comparatively little sweating ; the perspiration at that time formed, is also, possibly, different from that poured out at the commencement of the case ; there is a rapid arrest of the circulation, without elimination of serosity. In other words, the prominent symptoms in the worst cases of Cholera, viz. the changes in the respiratory and circulatory functions, cannot be measured by the amount of vomiting and purging, are in many cases in an inverse ratio to these latter symptoms, and do not follow rapid separation of serum, but are present from the commencement of the attack.

2. In another class of cases there is great purging and sweating, but the algide symptoms come on late, and the case is altogether slighter.

3. If great purging and loss of watery fluid induce the peculiar symptoms of Cholera, ought not these to follow more frequently certain forms of dysentery and diarrhoea ? Supposing that there are passed from six to twelve copious stools in Cholera, is there not sometimes in dysentery, for days together, an immense number of loose stools ? How often in diarrhoea with remittent fever do we see exceedingly copious watery purg-

ing, which, though it reduces the strength greatly, does not lead to the distinctive choleraic symptoms.

The separation of the serosity, or watery part, is evidently one of the minor chemical changes in the blood. It is seen chiefly at the commencement of the slighter cases when the cause is beginning to act, and it is seen in other diseases in which it is not succeeded by those further chemical changes in the blood which give rise to the algide symptoms of Cholera.

Moreover, the watery part of the blood is not the only ingredient thrown out; a proteine constituent is found in large quantities in the intestinal canal, but is not discharged by stool: sometimes, when there are only two or three watery stools, the intestines after death are found to contain a large quantity of this thick whitish or yellow substance, which dissolves in a warm solution of soda, and is precipitated by acids. Here there is a separation of an ingredient much more important than the water and salts, but the amount of which cannot be estimated by, and, in fact, bears little or no relation to, the watery purging.

Are the changes in the blood represented by this effusion, combined with more or less watery elimination? To this question a reply must also be given in the negative. The quantity of clotted substance effused into the intestinal canal, although generally great in malignant cases, is not in absolute proportion to the severity of the case. In those fatal instances, when, as Mr. Scot says, "an arrest of the circulation comes on from the commencement, and the patient dies without a struggle," there is comparatively little of the proteine compound effused. In fact, there is in all probability

no time for such effusion, for the blood stagnates in the capillaries, and the tumultuous though irregular action of an overburdened heart cannot drive it onwards. The effused substance is in reality an effect of some prior change, and requires conditions for its manifestation which are inconstant and variable.

Therefore it is to be concluded that the elimination of water, and of albumen or fibrine, into the intestinal canal, or upon the skin, are uncertain and changeable symptoms : there must be some other change in the blood within the vessels, which is not yet recognized by us, but truly latent and occult ; and which is the first effect of the reception and incubation of the choleraic virus.

The condition of the fibrine in the blood seems to afford some clue as to the nature of this change. In some cases there appears to be a total want of the fibrine after death ; in other cases it separates either before or after death, forming polypi and loose coagula in the heart and large vessels ; while in other cases in which it still remains in sufficient quantity to cause coagulation when drawn from the body, we must still conclude from the grumous clot, which does not contract and expel serum, and from the dark red fluid in which the imperfect coagula float, that the quantity of fibrine is diminished, and perhaps its mode of combination altered. The opinion that the blood in Cholera is thicker than usual, appears to me to have originated in the hypothesis which looks upon the purging as a draining of all the water of the blood, which then ceases to circulate on account of its density.

It is obvious, however, that with reference to those constituents which, *after death*, give it consistence, the blood in many cases is positively thinner than usual. If the blood were really thicker, that is, containing its usual quantity of fibrine, but with diminished proportion of water, what should we expect, when we allowed to stand a portion of dark blood from the roots of the lungs, the venæ cavæ, or the heart? Certainly, that a clot denser than usual would be formed: but this is not the case: if a clot forms, it forms rapidly, it is true, but it is loose; the fibrine, if it be present, separates at once, and then it is seen to be in smaller quantity than usual, and the red supernatant fluid is perfectly thin. In fact, the apparently thickened condition of the blood seems to arise from the unseparated portion of fibrine partially losing its solubility, and being suspended, as it were, in the serum.

The fibrine, then, in Cholera, seems to lose its solubility; it appears in some cases to be completely got rid of in some unknown way. It may, and probably really does, form part, or the whole, of the thick pasty substance effused into the intestinal canal. But it is also possible that gradually, as it becomes insoluble, it may be deposited in the capillaries or in the small arteries, and either form there a mechanical impediment to the passage of blood, or by causing the blood to be thus loaded and physically altered, render it impossible for it to pass along the smaller vessels, or, if it in part still passes through the capillaries, it may be incapable of undergoing some or all of the usual respiratory

changes. That there is some impediment or arrest of the circulation in the capillary system generally, and in the pulmonary capillaries in particular, appears almost certain, and it is by no means improbable, from the whole bearing of the facts, that this is due to a chemical change in the fibrine, and in its mode of combination, consequent on the direct action of the active cause.

If this prove to be correct, it remains to be seen how far the chemical alterations causing obstruction in the pulmonary capillaries, and those preventing the blood from undergoing the respiratory changes, are allied to each other, or whether the latter be a consequence only of the former.*

These presumed changes in the blood may be conveniently divided into three arbitrary stages ; and the varieties of Cholera are conveniently arranged in a corresponding order in the following way.

* Probably not : we see, in many diseases, alterations in the chemical process of respiration due to some alteration of the blood, without obstruction ; sometimes the temperature is increased, at other times diminished : and it is perhaps in this direction that we are to look for the next great step that will be made in the pathology of fevers, and other diseases in which the fluids are primarily and principally altered. It is certainly a very singular thing, that in Cholera the blood should retain its power, out of the body, of acquiring a red colour when exposed to the air in thin layers, and yet in the body, that this change, as well as the changes leading to the production of heat, should be interrupted. This certainly looks like obstruction only : but the whole question is very obscure.

1. Thus, if the final change at once occur, and there is a complete and rapid arrest of the circulation, either from the intensity of the cause or from constitutional predisposition, the worst variety is produced, in which "a mortal coldness comes on from the beginning." As the circulation is soon almost entirely arrested by physical alterations in the blood—presumably, changes in the fibrine—there can be little purging, and comparatively little sweating; there is always some effusion of the thick white substance into the intestines, but often little of the watery part of the blood. The symptoms might be inferred from a statement of this condition: we might have presupposed a very rapid loss of animal heat, loss of voice, deafness and vertigo, total arrest of all secretions, defective aeration of the blood, consequent dark colour of the surface, and early and deep coma. The singular loss of animal heat is doubtless attributable to the arrest of the chemical processes of the body, and as all the pulmonary changes are interrupted, it is impossible at present to indicate the exact share which the changes of the fibrine have in the production of this remarkable symptom; but the view which regards the fibrine, as well as the red particles, as a carrier of oxygen, and consequently as a generator of heat, is singularly in accordance with the phenomena of Cholera.

2. If the cause act with less intensity, we have the second variety, in which there is less physical alteration in the fibrine, and the circulation is carried on for a longer time. Consequently, the characteristic change is not evidenced solely or chiefly in the interior of the

vessels, but is partly transferred to the exterior of the vascular system. The proteine constituents, fibrine, and perhaps albumen, are effused in large quantities, and in all parts of the body, though chiefly on the free surfaces of the skin, alimentary mucous membrane, and more rarely the bronchial mucous membrane. This effusion, and its general nature, form two characteristic distinctions between Cholera and Diarrhœa ; for diarrhœa is a disease confined in the first instance to the eliminating parts, viz. the large or small intestines, as the case may be, and is unattended, as a general rule, by the effusion of albumen and fibrine.

The worst forms of this variety are seen in those cases, in which, after two or three Choleraic stools, severe and long-continued cramps come on, accompanied and followed by intense algide symptoms : after death the small intestines are generally found distended with the thick white flaky substance. Other cases of this variety present infinite modifications in severity, according as watery elimination is added to effusion of the fibrine ; in other words, according as they tend towards the slighter forms.

3. The slighter forms commence with much watery purging and vomiting, and pass into the first and second varieties in varying times. There may be from ten to fifty copious watery stools, and frequent copious vomiting, before there is any great loss of heat and failure of circulation. But there is always some degree of this even in the slightest cases, else the case would be mere watery diarrhœa, attended only by exhaustion, and not by the symptoms peculiar to

Cholera. Cramps are seldom present till the stools put on the true choleraic character, viz. of copious white flocculi suspended in a watery fluid. The algide symptoms came on gradually, and are less intense than in the former cases : recovery is also more common.

The quantity of watery fluid thrown out does not seem to bear any relation to the more important changes in the proteine constituents : when the one is excessive, the other is not equally so : and yet there can be little doubt that they are owing to the same cause, which produces a different effect according to its quantity and the intensity of its action.

That the watery purging is really to be included in the symptoms of Cholera, appears probable from the following reasons :—

1. Watery purging is one of the most common, and one of the earliest symptoms in the majority of cases ; in all, except those worst cases, in which the subsequent changes in the blood occur simultaneously, or very soon afterwards.

2. In the slighter cases, seen towards the close of an epidemic, when the active cause seems to act less powerfully, the purging of watery fluids becomes greater than in the earlier and severer cases.

And this watery elimination, even when only premonitory, seems to predispose, or to lead, to the changes in the proteine constituents, and therein to differ from ordinary watery diarrhoea, which has not this effect. This is seen in many instances, but particularly in cases of the following kind, which are often witnessed :—A patient is attacked with loose watery purging during

the prevalence of an epidemic of Cholera; this lasts for two or three days, or, on the contrary, only for an hour or two. Up to a certain point, although the stools may be numerous and very copious, there is not a single symptom of Cholera, except this purging, common to it and to many other diseases; and that the disease is not at this time choleraic is proved by the comparative ease with which the purging is arrested, and the patient cured: but if the case passes beyond a certain point, suddenly is voided a stool, watery still, but containing flocculi, and in an incredibly short space of time—as it appears to the observer, almost instantaneously—the pulse falls, the lips get livid, and the eyes dark and sunken: the Cholera visage is in fact developed, the tongue becomes cold, and the voice altered. The blood has taken on its peculiar change, and the case passes, in a few minutes, from a trifling to a most dangerous disease. Perhaps, in a case of this kind, there will be only two or three more choleraic stools, making altogether only three or four rice-water evacuations.

In this case two things appear certain:—1st, That this serous purging was not true Cholera, because it was, up to a certain point, unattended by the characteristic symptoms, and because it is analogous to the numerous other cases of Cholerine, seen during an epidemic, which are arrested at once by treatment, and stopped before ulterior changes are induced: but, 2nd, This scrous purging was not the common watery diarrhoea witnessed in all countries, because it led on to sequences unknown in the latter case, and predis-

posed to changes in the blood peculiar in their nature and unique in their operation. But here there seems a transition into those cases of pseudo or false Cholera, in which there is an alliance with the algide Cholera on the one hand, and with common watery diarrhoea, or English Cholera, on the other.

The varieties in the post-mortem appearances can be also readily explained by a reference to the presumed changes in the blood.

Thus the appearances in the lungs may be classed as follows :—

1. In the slightest and most prolonged cases, in which there is a great separation of the watery part of the blood, not only in the intestines, but more or less throughout the body, the lungs are more engorged with frothy serum, contain more blood in the minute structure, and are more crepitant and less collapsed than in the severer forms.

2. In the second variety there is greater collapse and less frothy serum, and this is confined chiefly to the posterior and depending parts. The upper surfaces are often pale, non-crepitant, and exude little blood on section.

3. Finally, in the worst forms, in which there are few stools, the lungs are excessively collapsed; sometimes without either blood or serum, almost entirely destitute of air, or with a bruised semi-hepatized appearance, having, apparently, as Annesley remarks, “lost the character and structure of lungs.”

The appearances in the heart are not so readily explained.

1. The common appearance, flaccidity and dilatation of the right side, contraction of the left, is at once understood as a consequence of the impediment in the lungs.

2. But in other cases the cavities are flaccid immediately after death, and contraction of the left side occurs afterwards. I observed this in some very severe and rapid cases. It is possible that this may have been merely an effect of the commencing rigidity.

3. In some few instances all the cavities were flaccid, and remained so : these were all severe cases, but not invariably the most malignant.

The state of the blood was as follows.

1. In eight cases, out of thirty-four, in which the blood was absolutely incoagulable, the type of the disease was intensely malignant. In the more prolonged cases, the polypi in the heart were larger, firmer, and more constant in their occurrence. In other cases it was impossible to annex the degree of malignancy to any particular condition of the blood.

2. In the cases dying in an early stage, before the algide stage had reached its acmé, from some unknown cause, and generally in convulsions, the blood coagulated.

The symptoms and post-mortem appearances are, then, in accordance with the hypothesis in the generality of cases. But it is not to be denied that difficulties still remain, which seem to indicate that future investigation will modify, or express in a different way, the effects of the changes in the proteine constituents of the blood,

so prominently put forward in this statement of occurrences.

1. Thus, if the characteristic changes in the blood occur indifferently throughout the body, how is it that there should be so great a passage of fluid by the intestines and skin, and so little by the kidneys? It is true that I have given some reasons for thinking that, in the stage of premonitory watery diarrhoea, and even in the true choleraic period, urine is passed more frequently than is supposed, and that the period of complete suppression corresponds generally with the deep algide stage, in which the purging also is arrested. But still a great difference certainly exists in the quantity got rid of through these two excretory passages. It might be supposed that the effusion of the proteine constituents into the urinary conduits blocks up these delicate tubes; but then, in cases of recovery, there is, as yet, no evidence in the urine of any such effusion being got rid of; the urine is generally transparent, of a yellow colour, and, in two or three experiments, was not coagulable by heat or nitric acid. I am not prepared to say, however, that in all instances it was not albuminous.

In some cases in which it was not tested the urine was certainly very turbid and sedimentous. In many cases also, the first portion of urine, during recovery, was passed with the stools, and therefore could not be examined. It must be remembered also that the cases of recovery are the slighter ones, in which the suppression of urine is less rapid and complete, and the effusion into the tubes, supposing it to exist, is, of course, in a very moderate degree compared with the

severe and fatal cases. To the naked eye, the kidneys do not appear much altered, but a microscopic examination, which would clear up the point at once, has not yet been made.

2. Another doubtful point is the condition of the lungs in some cases. Can the occasional extraordinary collapse of the lungs be attributable solely to an obstruction in the capillaries, and would the mere absence of blood thus necessitate the absence of air? So extreme is the collapse, that several observers have opened bodies under water, believing that air must have been generated in the pleural cavities; but this was found not to be case, and the shrinking of the lung must consequently depend on some cause existent in itself. It appears, however, that this shrinking can during life be overcome by the voluntary efforts of the patient, or by artificial inflation, without beneficial effect on the disease, and that it is therefore merely a consequence. Is it possible that the muscular contractility of the tubes could be increased? That the general muscular contractility is unimpaired is abundantly proved from the state of the left ventricle, of the colon, of the urinary bladder, or of the voluntary muscles excited to spasm by reflex action; but there is no evidence that it is augmented. At least I can perceive none, unless this state of the lungs be considered to be such. It would appear, however, that the comparison of Cholera and Tetanus which has been made by some writers must have arisen in a recognition of some of these conditions.

It might be supposed also that if there were a de-

position of fibrine in the capillaries or minute artcries, the lungs would be always engorged, perhaps cnlarged, and would universally present a more condensed or semi-hepatized appearance than could be accounted for by the mere condensation of the tissue and approximation of the molecular particles. In fact, they ought to present in *all* cases the appearances witnessed in some. I admit the force of this objection, but I do not think it conclusive in opposition to the strong reasons for believing in the deposition or physical alteration, in some way, of the fibrine. It is not to be supposed that in a disease so rapid as Cholera, there would be time for great accumulation of solid proteine compounds in the pulmonary capillaries: in fact, the hypothesis does not suppose the accumulation to be considerable, but merely to be sufficient to impede the circulation, and to hinder the respiratory changes. Besides, in the cases of extreme collapse of the lungs, which are generally the most rapid and fatal, it may be presumed that the alteration of the fibrine is almost simultaneous throughout the body, and then of course the lungs will not shew a greater indication of this than other parts. Or, the obstruction may be regarded as partial, and more importance may be attributed to the incapacity of the blood, although still in some degree circulating, to enter into combination with the atmospheric air.

On examining the cases which shew this extraordinary collapse more closely, they are found to present two varieties.

(a.) Thus, in some cases the lungs are excessively shrunk, and contain no blood or serum in their minute

structure, but yet on cutting through the roots, a large quantity of blood gushes out, affording us some indication of obstruction.

For example, a most malignant case in an English soldier was admitted into hospital at half-past 2 A. M., having suddenly commenced at half-past 1 A. M. The patient died at 10 A. M., having been ill only eight hours and a half : he was purged several times before admission, but not afterwards : there were severe cramps, and after death a considerable quantity of the flaky substance was found in the intestinal canal : the respiration was from the first in the highest degree laborious. This individual was 5 feet 6 inches in height, and, though not a large man, was tolerably athletic : he had always had good health, having never to my knowledge been in hospital during the previous eighteen months for any complaint. He was a drill-sergeant, and I remember remarking many times that his voice in giving the word of command was full and powerful. The body was opened in less than an hour after death ; muscular contractions continued for some time longer ; the right lung weighed only 8 oz., and lost no weight by cutting and draining, containing, in fact, no blood or serum, but being excessively contracted, and lying back on the vertebral column. The left lung, equally collapsed, dark red, and non-crepitant, weighed only 6 oz. ; sliced and placed in water it absorbed it, and gained 1 oz. in weight. But from the roots of both lungs when cut, and particularly from the pulmonary arteries, a large quantity of dark blood gushed ; 24 oz. were measured, but several ounces

more escaped into the cavity of the thorax. This blood formed immediately a loose, dark, unshrinking coagulum. All the cavities of the heart contained blood; the right auricle and ventricle were distended, as well as the coronary veins, the venæ cavæ, and the venous system generally; the blood from the heart coagulated in a few minutes, and expelled a small quantity of dark red serum. The ventricle was at first flaccid, and did not contract by mechanical irritation, but in a few minutes commenced to contract, and in half an hour was most firmly contracted: this occurred while the muscular contractions could still be excited in the abdominal muscles by pricks with the scalpel.

In this case the man did not die from vomiting and purging; for these were trifling: he did not die from any paralysis of the heart, for this acted well during life, and contracted after death: he died because the blood did not pass through the lungs, as evidenced by the quantity of blood in the pulmonary arteries; and I need not return to the arguments previously stated to prove that this was most probably owing to lesion of the blood. At any rate, this case, and others like it, as showing obstruction in the lungs, do not invalidate the hypothesis.

(b.) In other cases, however, the lungs are also excessively shrunk, and contain no blood or serum; and yet on cutting through the roots no blood escapes, and all the cavities of the heart are nearly empty. There is, therefore, no evidence of obstruction.

Thus an English soldier was admitted at 6 A.M.: he had been ill five hours; had vomited twice; been

purged several times, but did not know the number; had had no cramps, and passed urine immediately before admission. He had three more stools after admission, and died in nine hours, or in fourteen from the first stool. He was a man of 5 feet 6 inches in height, very powerfully and strongly made, and had always enjoyed good health. He was opened within an hour after death. Each lung, completely collapsed, weighed only 8 oz.; and 3 oz. of blood, which did not coagulate, escaped from each root. The left side of the heart contained, absolutely, no blood, and was flaccid when the body was first opened, but had contracted in two hours afterwards. The right side contained only a small quantity of dark incoagulable blood; a small quantity of blood, collected from the internal jugular vein, coagulated loosely. There was, certainly, some congestion of the general venous system, but not to the extent which would prove obstruction sufficient to account for death. It appeared, however, in this case, that the heart was affected in a greater degree than in most cases: the pulse was exceedingly weak on first admission, and soon became imperceptible; the impulse of the heart was hardly felt, and the sounds were very low. It may therefore be presumed, that the heart in this instance really did partially lose its contractility, though from what cause arose a result so much at variance with the majority of cases of Cholera, cannot be known.

The state of the heart merits, indeed, an extended investigation. Why its contractility should fail in some cases, and be evidently unaltered in others, is a

point of great interest. Is it possible that the right ventricle could alone lose its contractility, and the left preserve it? Whatever determination may be arrived at in this matter, will not, however, affect the general correctness of the hypothesis, nor its applicability to the majority of cases.

3. It might also be supposed, that if there were this deposition of fibrine in the capillaries generally, the arterial system would be full of blood, whereas the venous system is the most distended. To this it may be replied,—1st. That the whole circulating mass of blood must be in greater or less degree diminished in quantity by the drain from the system by the intestines and skin; and although this will not account for death, as has been already argued, and is not, indeed, in proportion to the most fatal symptoms, yet it might relieve the arterial congestion to some extent.—2d. That the hypothesis of obstruction supposes the chief changes to occur in the lungs, and that consequently the left heart, even from the first, receives a diminished supply of blood, while, by reason of its greater force, it may overcome the impediment in the general capillary system.—3d. The hypothesis, as already stated, does not consider the obstruction to be so intense as to lock up, all at once, the blood in the capillaries by completely filling these tubes. This would be to disregard altogether the chemical changes which have occurred in the blood, and which have unfitted it, evidently, to undergo its proper respiratory alterations.

An important inquiry naturally arises in this place.—Supposing that the phenomena of Cholera occur in

the order and manner now supposed, how are they related to the active cause, and in what mode are they produced by it? Is the choleraic virus absorbed into the blood through the lungs or skin, and then, by some catalytic or septic agency, does it excite in the whole mass of blood those chemical changes, variable in their intensity but definite in their nature, which the future course of the disease exhibits; or is the action of the poison principally upon the nervous system, or upon the whole vital agency, and thence secondarily on the tissues of the body and on the blood? Questions not yet to be definitely settled, or to be argued otherwise than as probabilities, not as certainties.

It may be said that there is a degree of vagueness and uncertainty in the terms "depressing action on the nervous system," or "diminution of nervous or of vital power;" and that their meaning is not sufficiently obvious for a fair argument. In Cholera there is no diminution of sensation, except what obviously arises in the developed stages, from the peculiar condition of the circulating system; there is no alteration in the power of motion beyond the general feebleness, consequent on the arrest of the flow of blood, or the cramps, dependent probably on excito-motory action; the intellectual faculties are singularly intact, and are often retained to the very moment of death. The "diminution of nervous power" must mean, I conceive, the suspension or lessening of that peculiar and unexplained force, which influences the secretive and excretive processes of nutrition. But I question if anything could be vaguer than such an hypothesis applied to Cholera. An unknown agent

acts in an unexplained way upon an organ whose ordinary actions are only partially known; this agent does not affect the obvious and ordinary actions of this organ, although these appear intimately united, or indeed essential to its more recondite powers over nutrition, but it selects one peculiar and obscure force on which to manifest itself: by this action certain symptoms are presumed to be produced, whose relation to the producing cause is as doubtful as the rest of the speculation. The only grounds on which such a speculation can be founded, are those early symptoms of deafness, debility, and anxiety, which are witnessed in all rapid cases; but these are too common in other diseases to claim such importance here.

If, in certain diseases, there is perhaps sufficient evidence of an influence exerted by different agents upon the cerebro-spinal or the ganglionic system of nerves, the nature of this action in the case of Cholera is in the highest degree obscure, and incapable of expression; and I say this with the highest respect for those writers who refer the changes in the blood to unrecognised conditions in the nervous system. I do not deny such changes; I only believe that some more definite expression must be attached to them, before they can be properly discussed.

If the share which a presumed diminution in the nervous power plays in Cholera be considered doubtful, the same thing cannot be said of certain individual nerves, as the vagus and the phrenic, which have been accused of imperfect action. Here there certainly is no apparent loss of power or modification of function.

The patient, as long as he remains sensible, can put in action any of the muscles of inspiration or expiration ; the articulation though low is always distinct; each syllable is perfectly formed, and there is no spasm of the glottis, so that the superior and inferior laryngeal nerves appear unaffected.

In favour of the view that the poison of Cholera is inhaled into the lungs, and acts chemically on the blood in the pulmonary capillaries, it may be alleged that the first effects of the poison are often of the kind which would be produced by some impediment to free respiration : slight dyspnoea, tightness across the thorax, a feeling of anxiety from some lessening of aération, an acceleration of the respiratory movements, are very usual symptoms. The necessity also for admitting that the active cause of Cholera exists in the atmosphere, and moves with bodies of air, seems to accord with such a view. But whether this be not too mechanical and easy an explanation, and require assumptions almost as great as the hypothesis of nervous derangement, is a point for future discussion and determination.

CHAPTER VI.

ON THE AFFECTIONS CONSECUTIVE TO CHOLERA.

I HAVE already intimated, that I do not adopt the opinions of those who regard the blue stage as only an initiatory period, and compare it to the cold stage of ague; I consider the cold stage as the real disease, which, at its termination, is succeeded by various forms of reaction, according to the severity of the case, the kind of epidemic, the constitution of the individual, or even, it may be, according to the treatment employed. Therefore it might be inferred that consecutive fever would be sometimes absent, and sometimes present. And this is really borne out by the experience of Indian practitioners, although it is not strictly in accordance with observations made in Europe, where consecutive fever was more generally noticed.

My conclusions, however, so far differ from Annesley and some other Indian writers, that I believe some form of reaction to be much more common after Cholera than they have allowed. Consecutive fever does not follow pseudo-cholera, or very slight cases of true Cholera, or even well-marked cases of moderate severity, such as those formerly detailed, but most certainly very severe cases seldom or never attain con-

valescence without passing through some transition stage. This agrees also with the observations of Jameson and Scot.

Six or eight varieties of consecutive fever might easily be made: I shall only very briefly notice those I have myself witnessed.*

The most common form of reaction is that witnessed in the milder cases. I have already described this at a former page; the warmth and circulation gradually return, and a mild febrile exacerbation follows, which subsides naturally in a few days.

In other cases, after the patient has remained for some time cold and semi-comatose, warmth is gradually regained, as in the former case; the tongue becomes brown; there is distressing hiccup, and occasionally vomiting; dark or grey offensive stools are passed; the urine, which requires generally to be drawn off, is scanty, turbid, and offensive, or occasionally yellow and transparent. The breathing is usually hurried, and there is some cough and slight frothy expectoration. Sometimes, however, there is no cough or expectoration, but there is dulness on percussion over the bases of both lungs posteriorly. The pulse is labouring, the face flushed, the conjunctivæ reddened: the patient is restless, irritable, and occasionally delirious. There is

* In 1843 I had an opportunity of confirming the observation of several writers, that subacute gastritis and visceral affections, particularly of the liver, are common after mild attacks of Cholera. But my cases were too few in number to allow me to arrive at any conclusions worth detailing.

often a peculiar typhoid odour from the body, very different from that of the algide stage.

The pulmonary and the abdominal symptoms are generally combined; sometimes the former are masked by the latter.

Occasionally the cephalic symptoms are more prominent. Nearly complete coma supervenes on the semi-comatose condition of the cold stage; the skin becomes very hot, the pulse strong and labouring; the conjunctivæ are red and glazed; the pupils generally contracted. Occasionally there is subsultus tendinum, and laborious or even stertorous breathing. If the stupor be less intense, and the patient can be roused, he complains of intense headache.

The post-mortem appearances, in these cases with cephalic symptoms, do not shew much more accumulation of blood than is witnessed in the algide stage. I have opened the heads of several of these cases when I had not time to examine the whole body. I never found any effusion of lymph, or any great increase of red points on section, or softening in any part of the brain, but merely fulness of the sinuses and veins of the pia mater.

The following post-mortem examinations are all that I have made with sufficient care to warrant their insertion. The preceding account of the symptoms has, however, been drawn from a much greater number, both of fatal cases and of cases of recovery. The cases I now detail are too few to allow me to draw any conclusions from them.

CASE I.—*Cholera and Consecutive Fever.*

J. W., an English soldier, æt. 21; height, 5 ft. 11 in. slender conformation. A patient in hospital with syphilis.

3 o'clock P.M. August 22d. — Transferred from Venereal Ward. States that he has been much purged since yesterday evening: last night he was hardly able to leave the rear, so frequent were the stools. He has vomited to-day about two quarts of fluid, and has been purged so often that he cannot tell the number of times, but says he has had seven stools in the last five hours. Passed urine half an hour ago. *Present symptoms.*—Stools watery, greyish, but without white flocculi; vomited matters watery and curdy; pulse of tolerable volume; skin cool; tongue cool; no cramps; eyes sunken; lips not livid; respiration easy; respiratory murmur tolerably audible all over the chest.—Commenced Acetate of Lead, gr. iij.; Opii, gr. $\frac{1}{4}$, every half-hour.

Quarter to 4 P.M.—One pill given and vomited another given and retained. One watery and greyish stool; tongue colder; voice, pulse, and surface the same. No cramps.

4 P.M.—Another pill given, and vomited; one stool, whitish, and with a caseous smell; face becoming more choleraic; tongue cold; pulse smaller; voice a little raised.

10 minutes past 4. — Pill given and retained.

Another stool, about $\frac{3}{4}$ xii. in quantity, and milky in appearance ; caseous odour not so strong ; pulse 100, so compressible as to be obliterated by the slightest pressure ; great thirst, and desire for acid drinks. Skin in some parts of trunk tolerably warm.—Nitric acid drink was ordered.

Quarter-past 4.—A stool, milky-looking, about $\frac{3}{4}$ vij. in quantity.

Quarter to 5.—Pill given and retained.

12 min. to 5.—A scanty congee water-stool.

5 P.M.—Pill given and retained.

5 min. past 5.—Another scanty congee water-stool.

10 min. past 5.—Another similar stool : vomited a great quantity of fluid.

Quarter-past 6.—Another congee water-stool.

Half-past 6.—Pill given and retained.

10 min. to 7.—A rice water-stool : cramps in the legs.

7 P.M.—Another stool.

5 min. past 7.—A scanty stool.

Quarter-past 7.—A scanty stool.

Half-past 7.—Pill given and retained.

10 minutes to 8.—Vomited a large quantity of fluid ; has had another scanty stool ; since five o'clock the pulse has been gradually lessening, and is now scarcely perceptible ; skin cold ; copious sweats since seven o'clock ; voice altered and lowered ; eyes sunken ; areolæ dark ; lips livid.

8 P.M.—Vomited once ; one stool ; after the vomiting, one pill was given and retained.

Quarter to 9.—No stool; pill given and retained.

Half-past 9.—Pill given and retained.

Twenty minutes to 10.—Skin cold; tongue cold; pulse 84, very feeble, and every now and then intermittent for two or three beats. Respirations twenty per minute, costal; eyes sunken; face pale, and slightly livid; deafness; voice at times a whisper. During the last half-hour the stools have passed from him involuntarily; the number and quantity cannot be known; is very restless; skin perspiring.

10 P.M., and half-past 10.—Pills given and retained.

11 P.M.—Has passed several stools in bed; cramps in the legs from time to time; skin cold; pulse perceptible; very small, but not intermittent. Pill given and retained.

Half-past 11.—Pill given and retained.

12 midnight.—Is getting drowsy; no stool.

Half-past 12.—Vomited a small quantity of fluid.

2 A.M., August 23d.—Pills given regularly; the last vomited with a great quantity of fluid; is very restless; skin cold and clammy.

4 A.M.—Feels easier; sleeps for some minutes every now and then: the skin over the whole body certainly appears warmer.

Half-past 4.—Cramps in the palm of the right hand; has been sleeping since last report.

5 A.M.—Cramps for a few minutes in the palm of the right hand. Pill given and retained.

7 A.M.—One or two pills have been given since last

report : is just now vomiting a large quantity of fluid ; he wets his lips continually, but is afraid to drink anything, as it immediately reinduces the vomiting ; no stool ; skin certainly warmer.

Half-past 7 A.M.—Skin moderately warm all over the body ; pulse small, very compressible ; eyes less sunken ; lips still livid ; has passed some stools in bed since last report.—Ginger tea, Oj.

12 meridie.—Has vomited six times since last report ; has had no stool or cramps ; says he feels easy ; skin and tongue warm, pulse very much stronger ; no dyspnœa ; he appears exceedingly weak and listless, and moans at times, though he says he has no pain.

8 P.M.—Skin warm ; pulse regular and strong ; feels a desire to go to stool, but can pass nothing.—Calomel, grs. ij. every four hours : wine and sago.

6 A.M., August 24th.—Slept at intervals during the night ; vomited after every calomel pill, not otherwise ; skin warm ; pulse strong, full, and rather sharp ; has had hiccup during the last four hours ; has passed no urine ; catheter introduced, and bladder found to be empty ; the last time he passed urine was thirty-seven hours ago.—Omit Calomel.

Vespere.—Vomited once or twice during the day ; hiccup at times, checked temporarily by effervescent draughts and mustard poultices ; skin hot, dry ; pulse full ; lips natural colour ; voice nearly natural ; no dyspnœa or cough.

Mane, August 25th.—Slept for several hours ; some vomiting, checked by effervescent draughts and small

doses of creosote and tincture of opium ; skin hot ; passed urine of his own accord the first time for fifty-six hours ; pulse 90, full and sharp ; voice good ; no pain anywhere, but seems very weak and languid ; urine pale-yellow, transparent, non-sedimentous, with an urinous smell.

Vespere.—Appears getting weaker ; constant nausea without vomiting ; some dyspnœa this evening ; moans incessantly ; skin warm ; thirst ; one loose dark stool.

Mane, August 26th.—Lies quiet ; vomits occasionally, and has hiccup ; passed a dark stool involuntarily in bed ; skin cool ; pulse 90, small and compressible ; tenderness in epigastric region.

Vespere.—Constant ineffectual attempts to vomit.

27th.—Several lead-coloured stools ; much weaker ; skin cool ; pulse smaller ; is perfectly rational ; no headache ; eyes not injected ; thirst ; restlessness.

28th.—Gradually sinking ; thirst ; pain on pressure over epigastrium ; will take no food.

August 29th.—Sinking ; is drowsy, but rational when roused ; no subsultus tendinum ; pulse small, intermittent ; skin cold ; dyspnœa ; constant moaning.

10 P.M.—Comatose ; breathing hurried and laborous, carried on apparently by reflex action, sometimes ceasing for more than a minute, and then there is a long gasping inspiration ; skin of head and trunk warm ; of extremities icy cold ; pulse intermittent ; eyes sunken, and fixed.

1 A.M., August 30th.—Expired.

Period in hospital 178 hours ; period from first attack about 194 hours.

Sectio Cadaveris twelve hours after death.

Head.—Weight of cerebrum, lbs. iiij. Av.; weight of cerebellum, pons, and medulla, $\frac{3}{4}$ vj. $\frac{3}{4}$ ij.

Sinuses of dura mater nearly empty; what blood they contained was thin, fluid, and did not coagulate: no fluid collected in occipital cavities. On section the brain was perfectly healthy; a few drops of clear fluid in the lateral ventricles; no unusual congestion of the choroid plexus; cerebellum perfectly healthy.

Chest.—On opening the thorax, the lungs were seen to be slightly collapsed from the ribs and sternum; they were dark on the surface, and there were numerous black patches, as if blood were effused into their structure: slight adhesions of left lung, recent and easily lacerated. On removing the lungs a small quantity of fluid blood flowed out of the roots; this did not coagulate, but formed a syrupy-looking fluid; after standing for twenty minutes it also became arterial on the surface. The lungs were for the most part crepitant, and contained much frothy serum; other portions were pale, bloodless, without serum, and non-crepitant.

Right lung.—Weight, $\frac{3}{4}$ xijj; left lung—weight, $\frac{3}{4}$ xijss. On section the right lung presented a red surface, darkly stained here and there, apparently from effusion of some portion of the blood into the pulmonary texture; there were no masses of blood, nor any pulmonary apoplexy properly so called; these dark portions of the lung exuded bloody serum; they floated in water, and on washing became paler, although the

dark bloody discolouration remained in part unaltered. The left lung presented the same appearances ; a dark surface on section, diversified by patches of dark bloody discolouration. This lung was less crepitant than the other, and in many parts presented a peculiar hard leathery feel, and a bruised semi-hepatised appearance. At the lower part of this lung the texture was paler, and perfectly non-crepitant : all parts of this lung floated in water.

The bronchial membrane of both lungs was pale, and covered with bloody frothy serum.

Heart.—Weight, 3vij. 3ij.; a small quantity of yellowish red serum in pericardium ; left ventricle firmly contracted ; right dilated. On cutting out the heart, two large polypi, mixed with some liquid blood, escaped from the right auricle. The left ventricle contained no blood ; small dark polypi among the columnæ carneæ of right ventricle ; valves healthy. The walls of the left ventricle were from four to six lines thick at the apex, and from six to nine lines thick at the base. The walls of the right ventricle were from two to three lines in thickness throughout.

The blood from the heart did not further coagulate ; the liquid matter was a thin reddish serum, from which the colouring matter commenced to be deposited, as an amorphous cloud, at the bottom of the vessel.

Abdomen.—Stomach and intestines greatly distended with fluid ; no vermillion flush on peritoneal surface of small intestines ; the colon and duodenum, near the gall-bladder, were stained deeply of a brownish

yellow colour. The ductus comm. choled. was round, and full of bile: bile could be pressed along it from the gall-bladder into the duodenum with great ease.

Liver.—Weight (without gall-bladder) lb. ij. $\frac{3}{4}$ x. On section, pale, and empty of blood. Yellow bile could be seen staining the portal canals. Gall-bladder contained about $\frac{3}{4}$ vss. of greenish yellow homogeneous bile, giving a yellow tinge to the hands. Lining membrane of a dark green, almost black colour.

Spleen.—Small, contracted. On section, firm, of a uniform red colour, Weight, $\frac{3}{4}$ ij.

Pancreas.—Weight, $\frac{3}{4}$ iss. On section, pale and healthy.

Kidneys.—Right: weight, $\frac{3}{4}$ vj. Left: weight, $\frac{3}{4}$ vj. $\frac{3}{4}$ ij. On section, both kidneys appeared perfectly healthy.

Bladder.—Flaccid.

Stomach contained a large quantity of a turbid yellow fluid; intestines also contained about Oij. of a yellowish turbid fluid, containing apparently some fæculent matter. Mucous membrane of stomach minutely and darkly injected: in two or three places it appeared as if the mucous membrane were ulcerating: there were minute depressions of a round or irregular form, and surrounded by a vascular zone.

Small Intestines.—Mucous membrane of duodenum of a dark slate colour; otherwise healthy. Mucous membrane of jejunum pale and healthy. Peyer's glands visible in ilium; white, not much raised. Solitary glands few, and very small. In cæcal portion of ilium

no solitary or agminated glands could be seen, but there was some dark venous congestion.

Large Intestines. — Perfectly healthy. Solitary glands visible, but not enlarged.

In this case there are many points of interest; but I can only advert to the most prominent. The disproportion between the excessive purging and the algide symptoms will be noticed. So slight, comparatively, were these latter, that I gave a most favourable prognosis. The acetate of lead, though given in very large doses, did not seem at all to arrest the vomiting and purging. The death was, I think, owing entirely to gastro-enteritis, and this possibly was caused or aggravated by the medicine, although other patients took larger quantities of the acetate of lead without the slightest irritation of the stomach.

CASE II.—*Slight Cholera, and Consecutive Fever.*

J. B., English soldier, æt. 26; height, 5 ft. 8 in.

Admitted half-past 9 A.M. 27th June, 1845. Says he has been purged for the last four days; stools watery, and passed without any straining. Has had no cramps. Voided urine at 7 A.M.

At present.—Headache and vertigo; pulse 100, full; thirst; skin warm; dark circle round eyes.

Half-past 10.—One copious watery stool; nausea, but no vomiting; skin warm; pulse 105, rather full; pain and burning at epigastrium; is very restless, and thirsty.—V. S. ad 3xvj.

The blood coagulated properly; two hours after-

wards much serum was expelled, and the clot was arterial on the surface.

11 A.M.—One watery stool: has vomited a calomel and opium pill and creasote draught.

12 meridie.—Cramps in the left leg. One watery stool; pulse small, 90; countenance collapsed; eyes sunk; skin still warm and moist.

Half-past 12.—Skin becoming cold; pulse small and quick. Has just vomited a small quantity of fluid, and passed a copious watery stool; respiration easy; trifling cramps in the lower extremities.

2 o'clock.—No vomiting or purging since last report; is lying quiet, and seems drowsy; skin and tongue cool; pulse 108, regular, but small and compressible; respirations 24 per minute; respiratory murmur clear; heart's action normal; eyes rather sunken; no cramps; thirst.

3 o'clock.—No stool or vomiting, or cramps; skin warmer; is uneasy and restless; pulse 112, feeble; respirations 22 per minute.

5 o'clock.—Pulse about 70, intermitting every now and then,—sometimes every fourth or fifth beat, and then regular for thirty or forty beats; one copious watery stool; skin warm; tongue warm and dry; seems drowsy and inattentive.

8 o'clock.—Passed a watery brownish stool; cramps occasionally from the toes to the thighs; pulse very small, almost imperceptible, but skin still warm. Has become again restless.

9 o'clock.—A scanty watery brownish motion; no cramps since last report; pulse again perceptible, 88.

11 P.M.—One watery stool; cramps in the left leg; breathing slightly laborious; thirst; restlessness; sleeps at intervals for a few moments, and then starts suddenly.

Half-past 12.—Two watery stools within the last half hour; pulse regular, but feeble, 84.

Half-past 2 A.M. June 28th.—Two stools.

Meridie.—No stool, vomiting, or cramps, since last report. Has been lying quiet; pulse small, but regular; skin warm; breathing hurried; no cough.

1 o'clock A.M. June 29th.—The pulse has been gradually rising in volume since last report; it is now of tolerable volume; the skin is warm; the conjunctivæ injected. Has had one greyish watery stool since last report. Appears to be becoming drowsy, but is quite sensible.

6 A.M.—Continued and troublesome hiccup for the last half-hour; is very drowsy; eyes turgid; has passed no urine; bladder empty.—Cold affusion.

10 A.M.—After the cold affusion the hiccup left him until within the last few minutes: is very drowsy, almost comatose.

The reports mention the same symptoms,—viz. recurrent hiccup, rapid respiration, red and suffused eyes, warm skin, tolerably full pulse, and semi-coma, until A.M. July 1st. There had been no stool, and a purgative enema which was administered returned without fæculent matter. The catheter was again introduced, and about Oij. of yellowish clear urine drawn off.

At 8 A.M. July 1st, stertorous breathing came on: the pulse, which had been slightly irregular for some

hours, became intermitting. The skin became gradually cold, and he died the same evening. The bowels had not been again moved.

Period in hospital, 106 hours; period from presumed first attack (including the premonitory diarrhoea), eight days and a half.

Sectio Cadaveris, twelve hours after death.

Head.—On removing the calvarium the dura mater was found to adhere to the bone with considerable firmness; veins of dura mater not congested. Weight of cerebrum, lb. ij. 3viss; weight of cerebellum, medulla, and pons, 3vijss.

Veins of pia mater not much congested; no fluid in occipital cavities; no fluid in lateral ventricles; a good many red points on section of the brain; nothing else abnormal.

Chest.—Both lungs slightly collapsed from sternum.

Right lung.—Upper lobes pale, flaccid, non-crepitant, exuding no blood. The lower lobe was dark and dense with blood. Many portions were evidently in an early stage of pneumonia; they were hard, firm, and sank in water.

Weight of right lung, lb. j. 3x. Washed and drained, this lung lost 3ij. in weight.

Left lung.—Weight, lb. j. 3iv. The upper lobe, like the right lung, pale, non-crepitant, collapsed. The lower lobe dense, heavy, sinking in water. Beneath the serous coat of the inferior lobe there were a number of round haemorrhagic spots. There was more frothy serum in this lung than the other.

Bronchial mucous membrane reddened; the tubes contained bloody serum.

The blood from the roots of the lungs was dark and fluid, and did not coagulate; the colouring matter became deposited at the bottom of the vessel. The blood from the large veins of the neck was dark and fluid, and did not coagulate, but like the blood from the lungs deposited colouring matter.

Heart. — Weight, 3x. The right cavities were slightly dilated, and contained some small polypi. The left cavities were moderately contracted. The walls of the left ventricle were about half an inch in thickness. Valves healthy.

Liver. — Weight, lb. iij. 3vij. On the upper surface there were various superficial yellow patches. On section, the liver was uniformly pale; the gall-bladder contained about 3iss. of thick greenish-yellow bile.

Spleen. — Weight, 3ixss. Rather enlarged; softened and broken down, presenting a grumous appearance on section.

Pancreas pale, and rather hard.

Right kidney. — Weight, 3vj. Apparently rather enlarged, and rounder than usual. On section, pyramids distinct; cortical substance wider than natural.

Left kidney. — Weight, 3vj. The cortical substance presented a streaky appearance, and, as in the other kidney, appeared broader than usual. Pyramids distinct.

Bladder. — Flaccid, containing about eight oz. of urine.

Stomach and intestines. — Contained a considerable quantity of a yellowish fluid.

Stomach. — Three or four large haemorrhagic patches

beneath the mucous membrane of stomach near cardia.
Consistence of membrane natural.

Small intestines.—Mucous membrane of duodenum stained deeply yellow. Valvulae conniventes in jejunum and upper part of ilium also stained yellow ; the intermediate membrane was pale. In the lower part of the ilium the mucous membrane was very pale. The solitary and agminated glands were few in number, and were not enlarged.

Cæcum and colon.—Calibre considerable ; marks of a few healed ulcers in cæcum.* Solitary glands numerous in ascending colon, but they were small. In the transverse colon they were very thickly crowded together ; some of them were two lines in diameter, with a central cavity, looking like a healed ulcer. Others presented no appearance of either depression or central spot, but were round, yellowish, and of various sizes, from an exceedingly small point to the size of the head of a large pin.

CASE III.—P. M., an English soldier, æt. 38, admitted 3 A.M. July 24th.

This was the most severe case I ever saw pass on to consecutive fever. As the case was one in which injections into the veins were used, and as I shall have to detail it in the chapter on Treatment, I shall now merely give the post-mortem examination.

The patient was 99 hours in hospital, and the whole illness from the first stool was 109 hours.

* From an attack of dysentery eighteen months before.

Sectio cadaveris, an hour and a half after death.

Height, 5 ft. 9 in.; a very large, stout man. Rigidity commencing.

Head.—Considerable congestion of the vessels of the scalp. The blood which exuded on section coagulated rapidly and firmly. Vessels of pia mater and the sinuses at the base very turgid with blood. There was some effusion of serum beneath arachnoid. The blood which flowed out of the sinuses of the dura mater, 12 oz. in quantity, commenced to coagulate almost immediately.

Weight of cerebrum, lb. ij. $\frac{3}{4}$ iiiss.; cerebellum, medulla, and pons, $\frac{3}{4}$ vj.

On section, the brain appeared perfectly healthy; it was not softened. There were a few red points on section.

Chest.—Both lungs slightly fallen from ribs and sternum.

Right lung.—Weight, lb. j. $\frac{3}{4}$ iv. Colour dark. Crepitant in some places, but not so much as usual: floated in water. Very little blood exuded from the lung; the small quantity that did so immediately coagulated. On section, the lung exuded some blood and frothy serum.

Left lung.—Weight, lb. j. $\frac{3}{4}$ ijj. This lung like the other was dark on the surface, and was non-crepitant in places.

Both lungs had somewhat of a leathery feel, and were hard beneath the fingers. The condition might be compared to spleenification, or a modification of hepatization. The mucous membrane of the bronchial tubes was dark.

Heart.—Weight, 3xiiss. The right cavities were flaccid, and contained some dark clots interlaced among the columnæ carneæ. The left side was more contracted than the right, but its cavity was still of considerable size. The walls were almost 8 lines in thickness ; the walls of the right ventricle were only 2 or $2\frac{1}{2}$ lines. The valves were perfectly healthy.

Abdomen.—The vena cava and the right renal vein were very much distended with blood. The blood from the vena cava speedily coagulated.

Liver.—Weight, lb. iv. 3vij. Much congested, exuding much blood on section, chiefly, however, from the larger vessels ; the lobules appeared pale and healthy. The gall-bladder contained about 3j. of dark viscid bile,—so darkly green as to be almost black : it was also rather stringy.

Pancreas.—Weight, 3iijss., pale and healthy.

Spleen.—Weight, 3x. On section, tearing readily, but not much softened.

Kidneys.—Either from original conformation or from disease of the other kidney, the right kidney was found enormously enlarged. It weighed lb. j. On section, it appeared healthy ; the pyramids were distinct, and the cortical substance normal. The left kidney weighed 3iij. ; it was flattened, and surrounded by fat. The pyramidal structure could not be seen. The pelvis and ureter were exceedingly small.

Bladder.—Flaccid, and containing several ounces of fluid.

Stomach.—Mucous membrane highly vascular towards cardia ; the redness was minute, vivid, and haemorrhagic. Towards pylorus the membrane was pale.

Duodenum.—Mucous membrane pale and normal.

Jejunum and ilium.—Mucous membrane stained yellow, particularly in the ilium. Solitary glands visible. Agminated glands not seen except in cæcal portion of ilium, where they were enlarged with dark spots and striæ on their surfaces.

Cæcum and colon.—The solitary glands were enlarged throughout: in addition, some of them were perfectly black with effused blood, and were surrounded by a dark halo, which, in many instances, did not lose itself in the surrounding pale mucous membrane, but terminated by a well-defined, though undulating, border. In this dark halo there were darker spots, apparently from the effusion of blood beneath the mucous membrane. In other places the glands were, like the intermediate mucous membrane, pale: this was particularly the case in the transverse colon. In the descending colon and sigmoid flexure the glands became surrounded with red areolæ, but this did not prevail to such an extent as in the cæcum and ascending colon.

CASE IV.—*Slight Cholera and Consecutive Fever.*

Kistnar, a Madras Pariah. A thin emaciated man, of original slender conformation.

Seen May 28th, 1843, 10 o'clock, A.M. Ill since 6 A.M.; six serous stools; pulse small; extremities cold; eyes sunken; voice lowered; great thirst.

6 P.M. May 28th.—Four serous stools; pulse 118, small; respiration hurried; is anxious and restless; features sharp; no urine; skin cold.

He remained during the whole of the 29th and 30th in the same state, inattentive, careless, without pain, cold, with a small pulse, and a shallow hurried respiration. June 1st, the Report mentions a gradual improvement: the pulse had become fuller; the skin warmer; he passed urine; there was much hiccup and epigastric soreness; the stools were dark-grey in colour; the skin soon became hot, and the pulse sharp. From this time to the 9th of June he presented the appearance of a man in the advanced stage of low fever; the breathing was hurried; he complained of pain in the chest or the epigastrium, it was not certain which; he shrank when pressure was made on the epigastrium; there was no cough.

On the 11th there was a low muttering delirium; the skin was perfectly hot and dry; pulse 100, sharp; he would not answer questions. On the 12th he was sinking, and he died on the 13th.

Sectio Cadaveris, sixteen hours after death.

Head.—No turgidity of scalp. On removing the calvarium the veins of the dura mater were found rather full of blood.

Weight of cerebrum, lb. ij. 5vi.; cerebellum and pons, 3v. 3ij. or within 3ss. of these weights. On cutting through the dura mater to remove the brain, a small quantity, about 3ij., of red serum escaped. Slight effusion of transparent lymph on vertex; veins of pia mater rather full, particularly towards posterior lobe, and on cerebellum; over one or two of the con-

convolutions the pia mater appeared stained with blood. Some slight effusion of serum between arachnoid and surface of convolutions. On section, some little, but not very evident increase of red points ; beneath pia mater cerebral substance quite pale ; the cerebral substance, indeed, appeared paler than usual. The brain being removed, about $\frac{5}{4}$ jij. of red serum collected in the occipital cavities ; about 3 ss. of serum in the lateral ventricles ; no redness of choroid plexus. On section, corpora striata and optic thalami perfectly natural, Cerebellum natural ; veins congested ; two or three red points on section of arbor vitæ : two inches of spinal cord being obtained, its veins did not appear turgid, nor could anything unnatural be perceived about it.

Chest.—Right lung : weight, lb. j. $\frac{3}{4}$ iv. $\frac{3}{4}$ iv. Cut, washed, and drained for two or three minutes, weight, lb. j. $\frac{3}{4}$ jj. Some slight old adhesions. The lung was excessively gorged with blood in the dependent parts, and with serum everywhere ; structure not softened ; in lower lobe, indeed, hardened and dark red, and at this point it was not crepitant. It was not exactly like hepatization, although it approached this. There were two or three small tumors at surface of lung, apparently carcinomatous ; one at apex, one in centre, and another at base ; the one in the centre was the size of a bean with a central depression, cutting hard under the knife, and presenting, in one part, a white glazed section ; in another, a redder glazed section ; the pulmonary tissue around it was studded with small whitish tuberæ. At one point on the surface of middle lobe, a mass of

tubercular-like matter was cut through, apparently disposed in a lobular manner, which was very distinct in one or two isolated masses a little distance from the main body: in these little points, which plainly by their aggregation formed the large masses, there were little dark central spots like the sections of small tubes, and when the mass was pressed purulent-looking matter issued from these dots. This tubercular-like mass was covered by the serous membrane; on the other mass, which looked like carcinoma, the pleura was, on the contrary, destroyed, and formed a kind of circle round the tumor. There were no cavities in this lung. In the bronchial tubes there is an immense quantity of frothy serum.

Left lung.—Weight, lb. j. 3ijss. Cut, washed, and drained, weight, 3xv. 3iv. No adhesions: on cutting through the root a large clot of blood was pulled out of either artery or vein, which was uncertain. This lung, like the other, was gorged with serum throughout, and with blood in the lower lobe, which was red and hardened. Several carcinomatous (?) tumors throughout both lobes. One superficial tumor on the upper lobe, with the serous membrane gone, looked as if about to ulcerate. Along the margin of the lower lobe were many small tumors, and one also in the substance of the lungs. In this lobe also was a small cavity filled with creamy pus, about 3j. in quantity, apparently not communicating with a bronchial tube, and with its walls formed by the pulmonary substance, red and hardened.

Heart.—Weight, when washed and drained, 3vj.

Small ; posterior coronary veins turgid ; muscular substance dark ; an immense polypus completely filling right ventricle, and stretching into pulmonary artery ; a smaller one in aorta ; walls of heart dark where in contact with polypus ; walls flabby ; no fat ; pericardium healthy ; mitral valve slightly rugose and thickened at the edge of the large flap. About 3*ij.* of blood drained from heart, formed after standing for half an hour a soft black coagulum, which stained the gallipot of a dark red.

Abdomen.—Liver : weight, lb. *ij.* 3*viij.* 3*iv.* with gall-bladder. Washed and drained for two minutes, lb. *ij.* 3*viij.* On section, of an uniform yellow or ochre colour ; no bile in portal canals ; no other appearance of disease. Bile of a red colour, nearly transparent, with a yellow deposit.

Right kidney.—Weight, after being washed and drained, 3*j.* It presented on section a white and red streaked appearance ; the space between the pyramids, as well as the cortical substance, altogether filled with the streaky substance : towards periphery, also, the white or ash-coloured component of this streaky substance existed in greater quantity, and appeared like dense fat traversed by red lines. One or two small tumors were divided, hard and white.

Left kidney.—Weight, 3*iv.* 3*vss.* The surface presented a mottled appearance ; a dark tinge seemed to be communicated to a white substance by innumerable small ramifications and points of vessels. The cortical part round this, and all the posterior part of the kidney, was occupied by a white substance, less streaky

and more abundant than that in the right kidney, and diversified by lines and points of vessels.

Spleen.—Weight, 5ixss., large and soft : when cut into, the knife scraped off the softened substance like coarse red eurrant-jelly.

Pancreas.—Weight, 5ijss. ; unaltered.

Stomach.—Considerable ramiform venous congestion, apparently cadaveric ; nothing else morbid.

Duodenum.—The part immediately beyond the pylorus was much rougher than usual, and round the dots was a minute redness. This was the only reddened part in the whole small intestine ; several portions of it were congested, but this was evidently venous and hypostatic. About a foot from the stomach was a gland of Peyer, about an inch long, lying across and bisecting two valvulae conniventes, and presenting the usual appearance of a white dotted surface, but not at all raised from the membrane.

There were a great number of these glands from this point to the commencement of the ilium, all having the same appearance ; some as much as three inches long, and half an inch broad, lying in the axis of the gut ; none reddened, and none with any filamentous or pilose appearance ; no sign of ulceration ; not one solitary gland could be seen.

The Peyerian glands could not be seen in the ilium. The coats of this part of the canal were remarkably thinned, apparently from atrophy of the muscular tunics. The mucous membrane was perfectly smooth, not red, glandless ; there was no secretion on it, and it appeared thinned ; not softened.

Cæcum and colon.—Some slight hæmorrhagic congestion here and there ; no glands could be seen ; no ulcerations ; mucous membrane apparently healthy.

Bladder contained some urine ; not opened.

Several *mesenteric glands* were enlarged, with a congested surface, and a dark section.

The post-mortem appearances in cases with full reaction, appear from these four dissections to be divisible into two varieties, according as the stomach and intestines, or the lungs, are chiefly affected. And these conditions seem to have been sufficiently indicated by the previous symptoms. It is a very interesting circumstance, that pneumonia, or a state approaching to it, should be so often present in consecutive fever, both in Europe and India.* And it would not be difficult to connect this with the peculiar condition of the pulmonary organs in the algide stage. The gastro-enteritis seems also to be a true sequence of the disease in many cases, and not to be a consequence merely of remedies. In the cases marked by coma and subsultus tendinum, there is generally considerable dark congestion of the veins of the pia mater, but I have never had an opportunity of going through the body with sufficient minuteness in those cases, to speak as to the conditions of the other organs. It is worthy of remark also, that in three of the four cases above given, the spleen was enlarged and softened.

* In Europe this state has been particularly pointed out by Jackson in Paris, and Dr. Budd in London.

CHAPTER VII.

ON THE DIFFUSION OF THE CHOLERAIC POISON.

I HAVE throughout this treatise assumed the existence of a special morbid agent or virus, by whose action or predisposed frames, the disease termed Cholera is produced. It is true that the argument for the existence of this virus is only analogical, for chemistry as yet takes no cognizance of the more subtle gases. But when the peculiar mode of spreading of the Cholera is taken into account, with the absence of any uniform atmospheric changes attending its attacks, we must admit that the presence of a materiae morbi, or septic agent, is infinitely more probable, than that a disease so uniform in its characters should be produced by atmospheric changes, inappreciable by meteorological instruments. What this poison may be, from what sources it is derived, whether it arose during some convulsion of nature, some strange aberration of seasons, or whether the ordinary decomposition of vegetable or of animal life produced it, is at present absolutely unknown.

I am very far from meaning to assert, however, that meteorological conditions are not necessary for the de-

velopment of the virus. The numerous observations made on this point, both in India and Europe, confessedly imperfect as they are, point with tolerable certainty to the necessity for certain conditions, without which the virus dies or becomes dormant. The chief points which may be said to be nearly determined are —1st. the comparative independence of the virus of the influence of temperature. I say comparative, for, of course, it is sufficiently obvious that hot climates, either by virtue of their heat, or of the other states necessarily resulting from this condition, are the proper birthplaces and foyers of the poison. 2d. The extraordinary influence which the soil often exerts upon the virus,—an observation made even by Girdlestone, and since his time confirmed amply by the experience of observers both in Asia and Europe: sometimes the poison seems to adhere to the soil, and to be contained only in the lowest strata of air; at other times it seems to be possessed of greater volatility, and to pass with rapidity over large tracts of country. 3d. The affinity of the poison for moisture, although there seems to be a point of saturation beyond which moisture checks the development. 4th. The remarkable predilection of Cholera for all places where human beings are thickly crowded together, and where the effluvia from the excretions are consequently abundant. These general results, drawn from an analysis of nearly the whole of the facts collected on this subject, are in accordance with what I have myself observed. I shall shortly give the history of two epidemics which fur-

nished me with the cases forming the groundwork of the present treatise.

The first of these epidemics occurred at Moulmein, in the Tenasserim Provinces, and lasted, with various remissions and intermissions, from September, 1842, to July, 1843. In the Reports of the Army Medical Board is an admirable sketch of the climate and medical history of this station. For those who cannot readily refer to this masterly production, I have ventured to add an Appendix, by which my readers may understand at a glance the peculiar nature of this climate. Suffice it now to say, that, from the complete demarcation between the wet and the dry seasons, the influences of a very moist and of a comparatively dry climate are fully manifested on diseases and on the healthy constitution.*

Some time in the early part of 1842, Cholera appeared in the northern parts of Burmah, and, passing in a southerly direction, committed great ravages, and caused great consternation, at Ava and Ameerapoora. After traversing these cities, it passed down towards Rangoon, pursuing the course of the Irrawaddy and its tributaries, and attacking chiefly, according to Burman report, the towns and villages situated on the banks of these rivers. Still pursuing a southerly course, in August it appeared in the Burmese town of Martaban, situated on the junction of three great rivers—the

* See Appendix : short sketch of the Tenasserim Provinces.

Salween, the Attaran, and the Gyne, and nearly opposite to the British settlement of Moulmein. In September it appeared in Moulmein, and continued to prevail, with greater or less violence, till July, 1843, when it disappeared, although an isolated case was occasionally seen during the two following years. Soon after its entrance into Moulmein, it was reported to have appeared in the villages to the south, on the banks of the Salween, and on the sea-side, and then, still travelling due south, it reached in November the second principal Burman town, Tavoy. Tavoy is a place of considerable size, and is situated about 150 miles south of Moulmein, on the bank of a broad shallow stream, loaded with debris from the neighbouring mountains. Cholera raged here with great fury for three or four months, and then gradually disappeared. Soon after entering Tavoy it was heard of in the villages round the city, and, travelling south, it shewed itself shortly afterwards (some time in January, 1843) in Mergui, the third principal town in the Provinces, situated on a small island formed by two branches of the Tenasserim river, opening into the Bay of Bengal, about 150 miles to the south of Tavoy. The seasons at Mergui differ from those at Moulmein chiefly in three or four inches of rain falling even during the dry months.

According to Burman report, the disease continued to pursue the same course through the Malay Peninsula and Siam; but this could not be positively known. During the time it was under observation, and traversing the British dominions, the north-east monsoon pre-

vailed; but during the time it passed through Burmah proper, the south-west monsoon prevailed; so that it might have appeared as if the disease spread against the wind. This monsoon, however, spends the greater part of its force before it reaches the comparatively dry plains of central Burmah.

During this progress from the north towards the south, Cholera, as already stated, attacked chiefly or exclusively the towns and villages stationed in low marshy places, on the banks of rivers, or on the shores of the sea. It did not extend inland, and the Burmans were accustomed to escape it by leaving their houses and travelling into the jungle. Directly the first death occurred in any village, the men deserted their fishing, or their paddy-fields, and, betaking themselves to their endless forests, preferred the chances of famine and the dangers of the jungle to the risks of exposure to the attacks of Cholera. They universally stated, that, though they were left without food by this flight, and were exposed to the burning noonday rays, and to the heavy tropical dews at night, yet Cholera invariably left them after the second or third day's march inland. The Burmese did not believe the disease to be contagious: they attributed it to the malice of "*nats*," or demons, and they treated it chiefly with the cold affusion, in which they placed some confidence, and with vegetable stimulants and aromatics, of which they possess a very great variety.

To return to the disease at it appeared at Moulmein. For many months it was confined almost entirely to the houses situated on or over the river, and chiefly to

the south end of the town. One side of the main street runs close to the river, and the great majority of cases occurred on this side; comparatively few on the other. The only individuals who were attacked on the hills were the Pounghees, or priests, a class of men devoted to a life of celibacy and religious observances, and whose frames are often weakened by the practice of a rigorous and ascetic penance. One of their rules compels them to live on alms, and to eat the rice given to them one day on the following: their food, therefore, is often rancid, and they are at all times subject to diarrhoea. This may, perhaps, account for there being among these priests a much greater per centage of deaths from Cholera than among any other class of Burmans.

The only Europeans attacked at the commencement of the epidemic were the sailors belonging to the ships in the river: the ships nearest the shore suffered most. Thus nine cases occurred on board H.M. brig Britomarte, lying close in shore; she was moved about a mile away, into the centre of the stream, and no more cases occurred. Three cases occurred on board H.M. brig Syren, also lying in shore: she was also moved into the centre of the river, and the Cholera immediately ceased. The 63d regiment sailed in September and October, 1842, for Madras. One transport being accidentally detained three days in the river, had fourteen cases of Cholera during the voyage; the other transports, four in number, got to sea at once, and had no Cholera. A few cases occurred during this time among the Euro-

peans on shore, but these consisted only of those who lived close to the river. No case occurred in the European and Native regiments, whose barracks are situated half a mile and a mile from the river, although these men were allowed unrestricted intercourse with the bazaar. After prevailing chiefly at the south end of the town, the Cholera spread gradually over the whole town, which extends for four miles along the banks of the Salwyn. After the cessation of the rains in October, there was first a great increase, and then a decided decrease, in the number of cases. This is proved by the following Table, drawn up with the greatest care, as to diagnosis, from the cases admitted into the Jail Hospital. The convicts are composed chiefly of Bengalees, Madrassees, Chinamen, Burmans, and a few Malays and Shans, and vary in number from 800 to 1200.

TABLE OF CASES ADMITTED INTO THE JAIL:

Month & Day.	No. of Cases on each day.	Kind of Weather during Month.	Month & Day.	No. of Cases on each day.	Kind of Weather during Month.
Sept. 2	1	Heavy rain : altogether 31 in. 2-10ths.	Apr. 16	1	
— 3	1		— 23	1	
Oct. 14	1	Rain till 12th of the month ; then fine weather, with a burning sun.	May 4	1	Hot dry weather till 16th ; then heavy showers ; then cessation till the 23d ; then rain to end of month : altogether 13 in. 2-10ths fell.
— 16	1		— 19	1	
— 17	2		— 20	2	
— 21	1		— 21	1	
— 23	1	Low lands still covered with water.	— 22	1	
— 25	1		— 23	2	
— 26	1		— 24	1	
— 27	1		— 25	6	
— 28	2		— 26	2	
— 29	3		— 27	3	
— 30	1		— 28	6	
— 31	1		— 29	2	
Nov. 1	2	Fine weather, with a burning sun.	— 30	5	
— 2	1		— 31	3	
— 3	4	1 inch of rain on the night of the 18th.	June 1	2	Heavy rain during the month : altogether 32 inches.
— 4	3		— 3	1	
— 6	1	Many of the low lands still flooded.	— 4	3	
— 8	3		— 5	1	
— 10	1		— 6	1	
— 11	1		— 7	1	
— 12	2		— 9	1	
— 13	1		— 11	2	
— 16	1		— 12	3	
— 18	2		— 14	1	
— 19	1		— 15	1	
— 25	1		— 16	2	
Dec. 4	1	Fine clear weather ; ground dry ; cold nights.	— 17	3	
— 11	1		— 18	3	
— 12	1		— 19	1	
— 17	1		— 20	4	
Jan. 2	1	Fine dry weather ; ground quite dry ; cold nights.	— 21	3	
— 10	1		— 22	5	
— 12	1		— 23	3	
— 16	1		— 24	2	
— 17	1		— 25	1	
— 26	1		— 26	1	
Feb. 1	1	Fine dry weather.	— 30	1	
— 18	1		July	2 or 3	cases during this month ; then complete cessation of Cholera.
March	No	case during this month ; weather becoming hot.			
Apr. 14	1	Dry hot weather.			A very rainy month ; about 34 inches.
— 15	1				

This Table shews the remarkable and gradual diminution in the number of cases, from November till the

middle of May, when the rains suddenly set in. It will be observed, that a sudden increase of cases occurred on the 16th of June. I notice, on reference to the Meteorological Table, which I kept at this time, that from the 8th to the 15th, little rain fell; but from the 15th to the 25th, the rain fell heavily.— I subjoin the Table for this period:—

Date. June.	Barometer.			Thermometer.			Pluviometer.		Winds. General Direction.	Weather and Remarks.		
	Sun Rise.	12 to 2 P.M.	Sun Set.	Sun Rise.	12 to 2 P.M.	Sun Set.	Noon to Noon.					
	Inches	10ths										
8	29.8	29.75	29.8	75	81	76	—	.1	W. & S.	Sl. showers; sun vis. all		
9	.8	.75	.8	74	80	75	—	—	W. & S.	Fine day; no rain. [day		
10	.81	.76	.8	74	79	74	—	.5	W. & S.	Showers; sun vis. most		
11	.8	.76	.795	74	78	74	1	—	W. & S.	Do. fineat int. [pt.of d.		
12	.815	.76	.79	74	79	75	—	.1	W. & S.	Sl. showers; sun very hot		
13	.82	.77	.81	75	79	75	—	.3	W. & S.	Ditto Do.		
14	.82	.77	.81	74	79	75	—	—	W. & S.	No rain Do.		
15	.85	.8	.83	74	80	75	—	—	W. & S.	Ditto Do.		
16	.85	.8	.84	74	79	74	2	.5	W. & S.	Heavy rain; high wind		
17	.87	.82	.85	74	80	74	—	.6	W. & S.	Occasional heavy showers		
18	.88	.85	.86	74	79	75	2	.7	W. & S.	Heavy rain; th. & light-		
19	.88	.75	.84	74	80	74	3	—	W. & S.	Ditto Do. [ning		
20	.88	.79	.83	74	80	75	2	.5	W. & S.	Ditto.		
21	.81	.75	.79	74	80	75	2	.05	W. & S.	Ditto.		
22	.84	.76	.81	75	80	76	2	.5	W. & S.	Ditto.		
23	.84	.78	.81	75	80	76	—	.25	W. & S.	Slight showers; sun vis.		
24	.89	.85	.87	74	78	75	1	.5	W. & S.	Heavy showers		
25	.82	.87	.88	72	76	73	2	.25	W. & S.	Heavy rain.		

At the commencement of the rains there was also a great increase in the number of cases in the Bazaar. The following statement, supplied by the petty Burman magistrates, or Goungs, to the civil magistrate, unfortunately ceases in March: it proves the decrease in the dry months. I cannot account for the increase in February; but this Table must not be considered at all accurate. I know, on good autho-

rity, that many Burmans died of Cholera, whose names are not returned in it.

Extract of the number of deaths by Cholera in the town of Moulmein, as furnished by the magistrates, from October to March: no returns from March to July. Estimated population of Moulmein, during that period, 25,565:—

Date.	Number of Deaths.	Date.	Number of Deaths.	Date.	Number of Deaths.
11 Oct. 1842	13	22 Nov. 1842	8	24th February	0
12 "	23			25 "	21
13 "	18	From 23d Nov.		26 "	0
14 "	33	to		27 "	7
15 "	16	13th of Dec.		28 "	7
16 "	27	inclusive		1st March	31
17 "	35		No returns.	2	5
18 "	26		Disea.inrequent.	3	6
19 "	43	From Dec. 14	Aver. 1 daily.	4	5
20 "	47	to 20th Dec.		6	2
21 "	36	From 21st to		7	3
22 "	47	27th of Dec.		8	1
23 "	51	inclusive		9	7
24 "	31			10	4
25 "	21	From		11	1
From 26th to		28th Dec. 1842		12	1
Nov. 1 inclusive	138	to		13	3
2 Nov.	12	10th Jan. 1843		14	2
3 "	16	inclusive		15	1
4 "	15		No returns.	16	3
5 "	21	From 11th to	Disea.inrequent.	17	1
6 "	15	17th Jan. 1843	Aver. 1 daily.	18	0
7 "	18	From 18th to		19	0
8 "	11	24th Jan.		20	2
9 "	9	From 25th to		21	2
10 "	16	31st Jan.			
11 "	9	From 1st to		Total	1377
12 "	9	7th Feb.			
13 "	15	From 8th to		The cases continued to	
14 "	10	14th Feb.	107	average 1 or 2 daily:	
15 "	9	16th February	7	when the rains com-	
16 "	5	17 "	7	menced there was an	
17 "	7	18 "	7	immense increase in	
18 "	8	19 "	11	the Bazaar, which con-	
19 "	9	20 "	11	tinued till July.—No	
20 "	8	21 "	15	returns were made, for	
21 "	10	22 "	9	fear of alarming the	
		23 "	21	people.	

During the whole of this lengthened epidemic, in the hot as well as the cold, in the wet as well as the dry months, the type of the Cholera continued generally the same. I witnessed it in persons of different nations,—in Europeans, Bengalees, natives of the Malabar and Coromandel coasts, Chinamen, Burmans, Shans, and Malays, and in the majority found it to present the symptoms of the more malignant types, with comparatively little vomiting or purging, but with early and rapid aberration of the respiratory and circulatory functions. The same observation was made by Dr. Richardson, civil surgeon and commissioner, and is recorded in a letter to me.

Although Cholera was thus constantly present in the habitations of the Burmese, densely crowded as they are, along the muddy banks of the Salween, the European regiment remained perfectly untouched till May, 1843.* On the 15th of May the rains commenced, and after a few heavy showers on that and on the three following days, abruptly ceased for some days; at the same time the thermometer fell rapidly from a daily range of 19° ; viz. from 78° to 97° to a daily range of 7° or 9° ; viz. from 75° to 82° or 84° . On the night of the 21st of May, a case of most malignant Cholera was admitted into the hospital, which proved fatal in

* No sanatory precautions were adopted, but the troops had free access to every part of the town. Two companies of English Artillery were quartered nearest to the town, but these men were untouched throughout.

about five hours ; and from this time forty-one cases, in European soldiers, were admitted up to the 1st of June ; after which time the rains having heavily set in, Cholera ceased, and did not again attack the Europeans.*

I give the meteorological table from the commencement of the rains to the 4th of June.

Barometer.			Thermometer.			Winds.	Pluviometer.		Weather and Remarks.
Sun Rise.	12 to 2 P.M.	Sun Set.	Sun Rise.	12 to 2 P.M.	Sun Set.		Noon to Noon. Inches	10ths	
29.93	29.83	29.92	78	96	80	Variable	—	—	Very hot day.
.93	.87	.92	80	98	82	chiefly W.	—	.10	Showers ; hot day.
.9	.85	.9	78	82	79	& S. or S.	1	.2	Heavy showers.
.9	.854	.9	79	84	77	ditto	—	.5	Showers.
.9	.85	.9	80	85	83	ditto	1	—	Heavy showers.
.9	.85	.9	80	90	83	ditto	—	—	Cloudy ; no rain.
.91	.85	.9	78	84	89	ditto	—	—	Ditto ditto.
.9	.83	.88	79	84	80	ditto	—	—	Ditto ditto ; day of attack.
.9	.84	.89	79	84	79.5	ditto	—	.5	Showers. [of Cholera.]
.85	.8	.85	77	82	80	ditto	—	.1	Showers.
.91	.9	.92	77	87	84	ditto	—	.1	Showers.
.89	.84	.86	77	86	80	ditto	—	—	Cloudy ; no rain.
.85	.8	.85	76	84	79	ditto	—	.1	Showers.
.85	.81	.845	76	83	79	ditto	—	—	Cloudy ; no rain.
.85	.8	.85	76	80	75	ditto	1	—	Heavy showers.
.85	.8	.84	75	79	76	ditto	4	.3	Continual heavy rain.
.86	.81	.84	75	79	76	W. & S.	2	.5	Heavy rain.
.84	.79	.83	74	78	75	W. & S.	5	.4	Continual heavy rain.
.83	.81	.8	74	78	75	W. & S.	1	—	Heavy showers ; Cholera
.85	.81	.91	74	78	75	W. & S.	—	.25	Showers. [ceased.]
.94	.8	.91	74	78	74	W. & S.	—	.5	Ditto.
.9	.85	.91	74	78	74.5	W. & S.	—	.25	Ditto.

Cholera did not cease in the Bazaar and Jail, however, till the rains had violently set in in July.

* Having unfortunately lost some of my notes of the cases of Cholera which occurred in the Europeans during this epidemic, I have been deprived of much confirmatory evidence.

From the gradual spread and variations of this epidemic, it appears probable that moisture in certain quantity is requisite for the choleraic agent, and from the manner in which, while raging as furiously as ever, it was checked by the deluge of rain brought up by the south-west monsoon, we may also infer that a very great degree of moisture again precipitates it, or renders it in some way innocuous and inert.

The second and shorter epidemic to which I referred seems to corroborate the inference drawn from the first. This recurred at Madras in 1845, and lasted from the 19th of June to the end of August. Cholera is not common at Madras ; the hot, dry, and sandy soil of this station is so absorbent of water that perhaps during the greater part of the year the climate is too dry for the disease, and during the remainder of the year the rains are generally heavy.

The 84th Regiment landed in Madras in excellent health in April, 1845. On the 19th of June, the first case of Cholera appeared, and from this time cases were admitted every two or three days, for ten weeks. A hot land wind during the day, followed by a heavy shower in the evening, generally produced one or two cases of Cholera in the next twenty-four or thirty-six hours.

A few days before the Cholera appeared in Fort St. George, it had attacked with some violence the 57th Regiment stationed at Arcot, eighty miles to the westward. After it had appeared in the Fort, we heard of its prevalence in the Bazaar and Black Town of Madras, but I could obtain no account of the number

of cases. I know, however, that it was very fatal, and created great alarm among the Hindoos.

I subjoin the meteorological table for June, July, and August. There was no rain in May, or in the previous dry months. The west and south-westerly winds are the land winds ; the east and south-easterly are the sea breezes.

METEOROLOGICAL TABLE FOR JUNE, 1845.—FORT ST. GEORGE, MADRAS.

Date.	Barometer.	Thermometer.		Pluviometer.		Winds.		Weather and Remarks.		No. of cases of Cholera admitted of men, women, and children, belonging to H.M. 84th Regt.	
				Noon to Noon.		General Direction.					
		Sun Rise.	2 to 2 P.M.	SunSet.	12 to 2 P.M.	SunRise.	10th.	A.M.	P.M.		
June	29.85	29.85	29.85	92	92	94	90	W.	E.	1	
1	.85	.85	.85	92	92	94	90	S.	E.	2	
2	.85	.85	.85	84	84	90	90	S.E.	E.	3	
3	.90	.90	.90	87	90	88	88	S.	E.	4	
4	.95	.96	.95	88	90	88	88	W.	E.	5	
5	.95	.95	.95	88	90	88	88	W.	E.	6	
6	.95	.95	.95	88	94	88	88	W.	E.	7	
7	.95	.95	.95	88	94	89	89	W.	E.	8	
8	.95	.95	.95	88	94	89	89	W.	S.E.	9	
9	.95	.95	.95	88	92	89	89	S.W.	S.E.	10	
10	.95	.95	.95	88	92	89	89	W.	S.E.	11	
11	.95	.95	.95	89	92	89	89	S.E.	Clear and sultry, a.m.	12	
12	.95	.95	.95	89	90	88	88	W.	N.E. & E.	13	
13	.95	.95	.95	88	93	88	88	W.	S.E.	14	
14	.95	.95	.90	87	92	88	88	S.W.	N.E. & E.	15	
15	.80	.80	.80	89	88	86	86	S.W.	S.W.	16	
16	.80	.85	.80	86	89	87	87	S.W.	S.E.	17	
17	.95	.85	.80	86	90	87	87	S.W.	S.E.	18	
18	.90	.90	.85	86	91	87	87	S.W.	S.E.	19	
19	.85	.85	.85	85	90	86	86	S.W.	S.E.	20	
20	.85	.85	.85	84	92	88	88	S.W.	S.W.	21	
21	.85	.85	.85	84	88	86	86	S.W.	S.W.	22	
22	.95	.95	.90	83	87	86	86	—	.028	23	
23	.90	.90	.90	83	86	85	85	S.W.	.019	24	
24	.90	.90	.90	83	86	85	85	S.W.	.032	25	
25	.90	.90	.90	82	88	85	85	S.W.	Not noted.	26	
26	.90	.90	.90	83	89	86	86	S.W.	.196	27	
27	.90	.95	.90	85	92	87	87	S.W.	S.W.	28	
28	.90	.90	.80	86	93	88	88	S.W.	S.W. & W.	29	
29	.90	.90	.90	86	96	95	95	S.W.	Two men.	30	
30	.90	.90	.90	86	96	95	95	S.W.	One fatal, 1 recovery.	31	
31	.90	.90	.90	86	96	95	95	S.W.	Fatal.	32	
									Fatal.	33	
									Fatal.	34	
									Fatal.	35	
									Two men.	36	

Date.	Barometer.			Pluviometer.			Winds.			Weather and Remarks.			No. of cases of Cholera admitted of men, women, and children, belonging to H.M. 84th Regiment.	No. of cases fatal or recovered.
	Sun. Rise.	12 to 2 P.M.	Sun. Set.	Sun. Rise.	12 to 2 P.M.	Sun. Set.	Noon to Noon.	Ins. 10ths.	General Direction.	A.M.	P.M.			
July	29.95	29.90	86	92	89	—	·150	W.	W.	W.	S.E.	Clear, a.m.; rain, p.m.	One man	Fatal.
2	·90	·95	84	94	91	—	·056	W.	W.	W.	E.	Cloudy & cool, a.m.; rain, p.m.	Recovered.	
3	·90	·90	85	93	90	—	·056	W.	W.	W.	W. & S.E.	Clear, a.m.; sultry; drops of rain	One man	
4	·95	·95	86	94	90	—	·056	W.	W.	W.	W. & S.E.	Clear, a.m.	Two men	Fatal.
5	·95	·95	84	95	90	—	·056	W.	W.	W.	W. & S.E.	Ditto, a.m.; sultry day.		
6	·95	·90	85	95	88	—	·056	W.	W.	W.	S.E.	Do.; cooler; shower at night	One man	
7	·95	·90	84	90	89	—	·251	W.	W.	W.	S.E.	Clear, a.m.	Fatal.	
8	·90	·90	85	94	90	—	·056	W.	W.	W.	S.E.	Do.; sultry day	One man	
9	·90	·90	85	95	91	—	·251	W.	W.	W.	S.E.	Clear, a.m.		
10	·90	·90	85	92	89	—	·289	W.	W.	W.	S.E.	Ditto; showers	One man	
11	·90	·90	85	94	90	—	·093	W.	W.	W.	S.E.	Cloudy, a.m.; sultry; showers	Recovered.	
12	·95	·90	85	93	90	—	·093	W.	W.	W.	S.E.	Clear, a.m.		
13	·95	·90	85	93	90	—	·084	W.	W.	W.	S.E.	Cloudy, a.m.		
14	·95	·95	86	93	90	—	·019	W.	W.	W.	S.E.	Light Cloudy, a.m.; rain & lightning last		
15	·95	·95	85	93	90	—	·641	W.	W.	W.	S.E.	Clear and pleasant, a.m.		
16	·90	·90	83	90	88	—	·046	W.	W.	W.	S.E.	Clear, a.m.; showers, p.m.	One man	
17	·90	·90	84	92	89	—	·833	W.	W.	W.	S.E.	Clear, a.m.; thunder storm, p.m.	Two men	
18	·90	·90	83	90	88	—	·131	W.	W.	W.	S.E.	Clear, a.m.; showers, p.m.	Recovered.	
19	·90	·90	83	88	87	—	·186	W.	W.	W.	S.E.	Do.; cloudy and showers, p.m.	One woman	
20	·95	·95	90	83	88	—	·009	W.	W.	W.	S.E.	Do.; drops of rain, p.m.	One man	
21	·95	·95	90	83	88	—	·009	W.	W.	W.	S.E.	Cloudy all day	One man	
22	·95	·95	95	83	88	—	·009	W.	W.	W.	S.E.	Sultry and cloudy; drops of rain	One man	
23	·95	·95	95	83	92	90	·009	W.	W.	W.	S.E.	Cloudy	Fatal.	
24	·90	·90	95	85	94	91	·009	W.	W.	W.	S.E.	Do.; cloudy and showers, p.m.		
25	·90	·90	95	85	94	91	·009	W.	W.	W.	S.E.	Ditto		
26	·95	·95	90	85	94	91	·009	W.	W.	W.	S.E.	Clear, a.m.; land-wind strong	All fatal.	
27	·90	·95	95	85	91	90	·009	W.	W.	W.	S.E.	Ditto; showers, p.m.		
28	·95	·95	95	85	90	89	Not noted.	S.W.	S.W.	S.W.	S.E.	Two men, one [child		
29	·95	·95	95	84	91	88	—	·1	S.W.	S.W.	S.E.	Ditto	Fatal.	
30	·95	·90	90	85	91	88	—	·5	S.W.	S.W.	S.E.	Ditto; sultry		
31	·95	·90	90	87	90	88	—	·5	W.	W.	W.	Ditto; shower at night	One man	

METEOROLOGICAL TABLE FOR AUGUST.—FORT ST. GEORGE, MADRAS.

Date.	Barometer.			Thermometer.			Pluviometer.		Winds.		Weather and Remarks.			No. of cases of Cholera admitted of men, women, and children belonging to H.M. 84th Regiment.	No. of cases Fatal or Recovered.
	Sun. Rise.	12 to 12 p.m.	Sun. Set.	Sun. Rise.	12 to 2 p.m.	Sun. Set.	Ins.	10ths.	A.M.	P.M.	SE.	W.	Cloudy a.m.; showers p.m.		
Aug.	29.90	29.90	29.90	85	94	90	—	•044	W.	SE.	Clear a.m.; rain & lightning attn.	Both fatal.			
1	•90	•90	•90	85	94	90	Not noted	W.	SE.	Cloudy a.m.; rain at night	One child	Fatal.			
2	•95	•90	•90	85	90	88	—	•483	W.	Ditto	Ditto.				
3	•95	•90	•90	85	90	88	—	•131	W.	Ditto	Ditto.				
4	•95	•95	•95	85	93	88	—	W.	SE.	Ditto and oppressive all day	One woman				
5	•95	•95	•95	85	93	88	—	W.	SE.	Ditto a.m.; rain at night	One man	Ditto			
6	•95	•95	•95	85	95	89	—	W.	SE.	Clear a.m.; rain p.m.	Ditto	Recovered.			
7	•95	•95	•95	85	92	89	—	•6	W.	Ditto; showers at night	Ditto				
8	•95	•95	•95	85	92	89	—	W.	SE.	Ditto; rain at night	Ditto				
9	•90	•90	•90	85	92	89	—	•408	W.	Cloudy a.m.; rain at night	One woman	Fatal.			
10	•90	•90	•90	84	90	89	—	•149	W.	Ditto	Both fatal.				
11	•95	•95	•90	84	91	89	—	•037	W.	SW.					
12	•95	•95	•90	85	90	88	—	W.	SE.	Clear a.m.					
13	•95	•95	•90	85	93	89	—	W.	SE.	Ditto					
14	•95	•95	•90	85	93	88	—	W.	SE.	Do.; cloudy, thund. & lightning					
15	•95	•95	•95	85	93	88	—	•121	W.	Clear a.m.; rain p.m.	[P.m.]	Ditto.			
16	•95	•95	•90	84	92	88	—	•019	W.	Ditto, ditto	1 Fatal, 1 re-				
17	•95	•90	•90	83	90	88	—	•4	W.	Do.; cloudy and drops of rain	Two men	[covered.]			
18	•95	•95	•95	85	89	86	—	W.	E.	Clear and pleasant day	One man	Recovered.			
19	•98	•95	•95	83	90	86	—	W.	SE.	Cloudy & cool a.m.; rain p.m.	One man				
20	•95	•95	•95	83	91	86	—	•2	W.	Clear and cool a.m.; rain p.m.	One man				
21	•95	•95	•95	84	92	87	—	W.	SE.	Clear a.m.	One man				
22	•95	•95	•95	85	92	87	—	W.	SE.	Ditto	Two men				
23	•95	•95	•95	85	91	87	—	W.	SE.	Clear all day					
24	30.00	30.00	30.00	•95	90	86	—	W.	SE.	Ditto					
25	29.95	30.00	30.00	30.00	85	90	85	W.	SE.	Cloudy and sultry					
26	30.05	30.00	30.00	30.00	84	86	85	W.	SE.	Cloudy and cool day, drops of rain	One woman				
27	30.00	30.00	30.00	30.00	84	87	86	W.	SE.	Clear	Two men				
28	29.95	29.95	29.95	29.95	84	88	86	W.	SE.	Ditto	One man				
29	•90	•90	•90	•90	85	90	88	W.	SE.	Ditto	Both fatal.				
30	•95	•95	•90	•90	84	88	86	W.	SE.	Ditto	Both fatal.				
					•90	84	86	W.	SE.						
					•90	84	86	W.	SE.						
					•90	84	86	W.	SE.						

In September one or two mild cases occurred, and the disease then disappeared.

The cases thus admitted, 45 in all, of which 33 were fatal, presented the symptoms of the more malignant types. I have excluded from the lists all slight and doubtful cases, and have thereby made the average of deaths greater than in the ordinary official returns, which necessarily include all cases approaching to Cholera, and whose insertion could not conveniently be made under any other heading.

These two epidemics are, I believe, fair types of the general mode in which Cholera spreads in India. In neither Madras nor Moulmein, at the time of its prevalence, were any unusual and noticeable deviations from the ordinary atmospheric phenomena; if, at Madras, there was some little delay in the appearance of the rains in May and June, this was not in any extraordinary degree, and was not, indeed, more remarkable, than in many other years, when Cholera did not appear. But, in both these epidemics, the main facts are similar to those deduced from the general observations of the majority of writers. Suddenly into either place, a new agent, for the inference is unavoidable, enters. It finds its conditions of development, not in any unusual atmospheric vicissitudes, but in the ordinary local and customary conditions. At Moulmein it prevails in one part of the town for months before it invades another: the only reason for this preference seems to be, that this part is nearest the river, and is the lowest, dampest, and most thickly populated quarter. It does not attack the residents on the high grounds,

and when it spreads from its original point of seizure, the conditions which allow of such spread are to be recognised in the occurrence of meteorological phenomena previously wanting. So also at Madras: the disease is heard of at a station ninety miles off; a few days afterwards it appears in Madras itself: the atmospheric phenomena are not very different from those of years unmarked by its prevalence; but there is a certain degree of moisture in the atmosphere, and a wind blows directly from the station in which the disease had shortly before been prevalent. It is very fatal in the Black Town, crowded with Hindoos, and in the quarter of the Musselmauns collected round the palace of their Nuwaub, both places dense with a dirty and offensive population; it is less severe in the fort, quartered by English soldiers and tolerably clean; it is not seen at all in the houses of the English residents, scattered for miles along the chief roads and the shores of the sea. In both cases, we have the usual evidence of a poison exhaled from unknown sources, and existent in the atmosphere, entering a town, and propagating itself more or less rapidly according as it meets with moisture, animal and vegetable effluvia, and perhaps other terrestrial exhalations which form the conditions which it demands for its development and increase.

CHAPTER VIII.

ON THE SPORADIC CHOLERA OF INDIA.

THE diseases which seem to be allied to Cholera are, on the one hand, those affections which manifest equally with itself an epidemic and pestilential character, but which are yet distinguished by well-defined symptoms, such as bubo-plague, yellow fever, sweating sickness, wide-spreading malarial diseases, and certain other complaints, which are now only historical; and, on the other, those disorders either epidemic or sporadic which have an absolute approach to it in their prominent symptoms. As examples, I may cite the pseudo-Cholera seen during an epidemic, the sporadic Cholera of India, the common autumnal sporadic Cholera of Europe, or certain forms of serous diarrhoea, attended with loss of animal heat, such as the disease said to be endemic in the Southern Mahratta country.

I shall merely enter into the consideration of these points, in so far as I have any thing to say derived from personal observation of pseudo-sporadic cases in India. My experience of these has not been sufficient to allow me to enter into a full discussion of the subject.

The cases met with in India, which have an affinity with true Cholera, are divisible into two kinds—those presented during the epidemic constitution, and the

sporadic cases from time to time witnessed on the march or in cantonments.

With regard to the first class of cases, those seen during an epidemic, there can be little doubt that they are referable to the action of the same cause which produces the severe or algid Cholera. But whether this cause differs in nature according as it differs in intensity, or whether it requires a peculiar predisposition before it can produce its pathognomonic symptoms, it is evident that its effects, as evidenced in the class of cases under consideration, are in the highest degree variable and diverse.

The numerous varieties of this class may be arranged in three divisions :—1st, cases attended only by a loose brown or watery, or serous diarrhoea, without marked symptoms referable to the respiratory organs. In the vast majority of cases this diarrhoea either cures itself or is cured by remedies. 2d. Cases characterized by copious purging, general and sometimes almost tetanic spasms, and a hot skin. 3d. Cases of serous purging, with some amount of refrigeration. As far as symptoms are concerned, the third class is the only one that approaches to algid Cholera. The other two classes do not present the characteristic feature, and one is even attended by a symptom directly opposed to it, viz. a hot skin. In these two cases, therefore, there can be no doubt that the peculiar change in the blood, whatever this may be, which causes the destruction of the heat-producing process, has not taken place. The cause has not proceeded to its complete development ; it has been only partially operative, and the disease it has

produced, although allied to algide Cholera, can never be considered identical.

The question is more intricate as regards the third class. On the one hand, it may be said that these cases are generally curable—that they even cure themselves, and that there is really a broad difference obvious to the clinical observer between them and the severe algide Cholera, which it may not be easy to put into words, but which has been recognized with greater or less distinctness by the majority of observers. In answer to this it may be argued, that an inferior degree of intensity is no proof of difference; that in these cases the symptoms when put upon paper are identical in character, and that so numerous are the grades of the disease, there is no possibility of drawing a boundary, and of defining the point where true Cholera begins and the pseudo Cholera ends.

As an illustration of this point I may shortly detail three cases—two very slight, the other more severe—of pseudo Cholera, seen during an epidemic.

1. M. S., European soldier, æt. 32. Admitted 28th August, 1845.

Half-past 2 P.M.—States that he was perfectly well till dinner time to-day (half-past 12); since dinner he has vomited three times; he has not been purged.

Present symptoms.—Is now vomiting; vomited matters bilious-looking; no giddiness or tinnitus aurium; no cramps; has not been purged; skin cool; tongue cool and moist; pulse feeble; no circle round the eyes; passed urine this morning. Commenced calomel and opium, small doses.

3 P.M.—Has vomited twice; slight cramps in the abdominal muscles.

Half-past 3.—Vomited a large quantity of greenish fluid; one copious stool, not watery, but having some consistence, of a dark brown colour, and very offensive; skin and tongue warmer; slight cramps still in the abdominal muscles.

4 P.M.—Vomited again a small quantity of a greenish fluid.

Half-past 4.—Skin and tongue warm; thirst is now urgent; slight indications of cramps in the calves of both legs.

He now commenced acetate of lead and opium.

Half-past 6.—Since last report he has had two stools, watery and scrous; slight pain in abdomen; slight and temporary cramps in the calves have just come on.

8 o'clock.—No stool; no cramps, and skin warm; has passed no urine.

10 o'clock.—Has been asleep for some time; no more vomiting; no stool; skin warm.

August 29th.—Has slept all night; this morning convalescent; feels quite well; has as yet passed no urine.

30th.—Quite well.

This case presents the very slightest form, attended with some coldness of the surface, which can be said to resemble the algide Cholera; the resemblance is wholly given by the reports at half-past 4 and half-past 6 o'clock. At this time it was apprehended that the severe form would have supervened.

2. W. C. aet. 18, European soldier—drummer.—
July 16.

Half-past 6 P.M.—States that he had diarrhoea yesterday, and cramps in the calves of the legs ; has had several watery stools to-day—he does not know how many. Since 8 P.M. has vomited twice, and has had three stools ; passed urine since 8 P.M. *Present symptoms.*—Tongue rather cool ; voice naturally low, apparently is not now lower than usual ; skin warm ; pulse feeble and compressible ; feels very weak ; has no vertigo or tinnitus aurium now, but says he had an hour ago ; is always deaf, but appears now deafer than usual.

Quarter to 10.—Slight cramps in the left calf ; no vomiting or purging ; tongue cool ; no thirst. The respiratory murmur is feeble, and the sounds of the heart are low.

10 P.M.—Cramps in both legs.

Ten minutes past 10.—Cramps in both legs and thighs ; the respiratory murmur is now heard more distinctly, and the sounds of the heart are normal in rhythm, and tolerably loud ; he has been moving about on account of the cramps, and this may account for the augmentation of the breathing ; pulse varies from 78 to 84, and is feeble ; skin rather cool.

Twenty minutes to 11 P.M.—One stool, like milk—8 oz. in quantity.

Ten minutes past 11.—Severe cramps in both calves.

Twenty minutes past 11.—The skin is certainly warmer, and the pulse stronger ; tongue warm ; cramps occasionally ; has passed no urine.

Twelve, *midnight.*—No cramps or stool since last

report ; has been sleeping at intervals ; says he feels easy.

Quarter to 5.—Has been asleep since last report, and is still asleep. The skin has become hot, and a gentle perspiration has just appeared.

Quarter past 5.—Is still sleeping ; skin warm, and very moist ; pulse natural in strength and rapidity.

Meridie.—Has passed urine freely ; feels perfectly well.

The next case carries the argument a step farther.

3. M. W., æt 24, Irishman.

July 3d, 6 A.M.—States that he was seized with purging yesterday while on guard. The stools, according to his own account, were dark, liquid, and copious ; there was no tenesmus. *Present symptoms.*—Skin warm ; tongue warm, with a brown fur ; pulse 80 ; some thirst ; slight rigors at times ; no pain across thorax ; passed urine freely immediately before admission.

10 o'clock.—He had an anodyne enema immediately after admission ; has had no stool ; has vomited twice : the vomited matter consists apparently of the fluids drank, and some pieces of beef which he took for supper. Since the last report, however, a considerable change has taken place. The voice is lowered ; the eyes are depressed, sunk in, and surrounded by a livid circle ; pulse 84, small and weak ; the tongue is loaded with a yellow crust ; skin rather cold, but moist ; skin of fingers corrugated.

2 o'clock P.M.—Vomited a little brown fluid.

Quarter-past 3 P.M.—Vomited again, a fluid of a

yellowish colour; skin cold; pulse 80, and very small; is very restless; no stool since admission.

Half-past 3 P.M.—A copious, watery stool, and cramps in both legs at the same time; pulse 78, feeble; constant thirst; great restlessness.

6 P.M.—One watery stool since last report; has passed no urine; is very restless and thirsty; occasional delirium; skin cold and clammy; pulse hardly perceptible; complains now of deafness and tinnitus aurium.

Half-past 8 P.M.—Has been without alteration till the present moment, when he has been seized with violent cramps or convulsions all over the body; no vomiting or purging; pulse just perceptible.

A dose of calomel, followed by opium, brandy, and spices, being administered, the spasms ceased, and he remained easy till

12, midnight.—No cramps, vomiting, or purging since last report; feels very weak and thirsty; pulse can be felt fluttering; hands and feet cold; countenance collapsed; eyes sunken, livid areolæ; tongue moist.

4 o'clock A.M., July 4th.—Has been asleep; skin still cold; tongue certainly warmer.

Half-past 6 A.M.—No alteration since last report; the pulse seems stronger.

9 A.M.—A return of violent cramps all over the body; no vomiting or purging; pulse just perceptible.

The cramps have now left him, and he is lying quiet.

12, midnight.—Since last report has had no vomiting, purging, or cramps; has been lying perfectly

still in a kind of sleep, or semi-stupor, rousing himself only to take his medicine (ammonia and eamphor) ; the skin is still cold, and there are profuse perspirations ; pulse firmer ; has passed no urine.

5 A.M.—No alteration.

7 A.M.—Has beeome very restless ; hiccup ; skin still cold, moist ; no vomiting or purging ; has passed no urine.

Vespere.—Pulse gradually regaining its volume, and the skin its warmth ; countenanee more natural ; has passed no urine.

July 6, *mane*.—Passed urine freely during the night ; oceasional hiccup ; bowels have been opened once, but the motion was not seen.

July 7.—Is quite well ; feels the limbs sore, and is redueed in flesh ; skin warm ; pulse natural.

I pass now to a brief eonsideration of sporadic cases in India.

That sporadic cases of Cholera should occur in the intervals of epidemic attacks in places subjeet to these latter, is no more than might have been anticipated from the oceurrence in other pestilenees ; as, for example, yellow fever and bubo-plague.

These sporadic cases are, as a general rule, much less severe than cases ocurring even at the latter period of an epidemie. Oceasionally they approach the pseudo Cholera of epidemics in certain symptoms—as, for example, in presenting spasms of extraordinary severity, ineluding the extremities and trunk at once, in the place of the gradual, suecessive, or erratic passive spasms of algide Cholera ; the quanitity of fluid passed

by stool is sometimes very great, and is ejected with great force : consecutive fever is a rare occurrence, and the mortality is comparatively small. This last remark does not, however, hold good always. In the early part of 1845, I witnessed in Calcutta several of these sporadic cases, of remarkable severity ; the men died as rapidly as at the commencement of an epidemic, and with the same degree of disordered respiration. It must be mentioned, however, that Cholera was at this time prevailing in the native town of Caleutta, as, indeed, it does nearly every year, although it was not sufficiently serious or extensive to be called epidemic.

The following case occurred in 1844. Epidemic Cholera had not been known in the station for eighteen months ; there had been no sporadic case for four months, and there was no other case subsequent to it for five months afterwards, while I remained in the station. It was, therefore, a genuine sporadic case, and illustrates very well the kind of disease on other occasions.

4. Khan Khool, Malay, æt. 35, a spare man, height about 5 feet 8 inches, said to be much addicted to opium-eating and smoking, and to smoking gunjah (hemp). Cholera. — Partial recovery ; consecutive fever ; death suddenly from dyspnœa.

Admitted 9 A.M., 12th December, 1844. Purged and vomited several times during last night ; two stools this morning ; vomited also undigested food ; the stools were watery and brown. *At present.*—Cramps in both extremities ; burning sensation at stomach ; pulseless at wrist ; skin of extremities cold ; warm on the

trunk ; restlessness and tossing about ; features sharp with sunken eyes ; voided no urine since yesterday ; voice feeble ; thirst.—Ammonia and stimulants given with opium ; then Calomel, gr. ij. ; Opii, gr. $\frac{1}{4}$; 2da quaqua horâ.

12 meridie.—Three scanty, watery, rather brown stools ; vomited twice some undigested food ; cramps slight and occasional ; voice inarticulate.

6 P.M.—No stool ; no vomiting ; pulse can now be felt at the wrist, fluttering.

December 13th. — Nine scanty, serous, grey-coloured stools ; vomited once, and brought up a lumbricus ; pulse can now be felt, small, feeble, and intermittent ; tongue cold ; appearance ghastly and cadaverous ; stupor ; no urine yet voided ; cramps altogether ceased.

Meridie.—No stool ; pulse feeble, but not intermittent.

6 P.M.—Two brown, loose, faeculent stools ; pulse feels better ; surface and tongue warm ; voice a little improved ; still stupor and drowsiness.

14th.—No stool ; vomited sago once ; has not yet voided urine ; no perceptible swelling in pubic region ; pulse still very small ; countenance slightly improved ; no thirst ; complains of feeling exhausted, and of being unable to sleep.

15th.—No stool ; slept a little ; passed no urine ; in other respects the same.

16th.—No stool ; catheter passed, and 3x. of urine drawn off ; in other respects as before.

17th. — Two moderate sized dejections yesterday ;

one scanty in the night ; pulse still feeble, and slow ; extremities cold ; eyes injected ; very troublesome hiccup since yesterday, relieved temporarily by ether and hyoscyamus ; 3vij. of urine drawn off by catheter ; complains of uneasiness all over abdomen ; breathing always hurried ; no cough.

18th.—Two moderate sized fæculent stools ; stomach irritable ; sickness after taking any thing ; pulse very feeble ; skin very cold ; hiccup ; passes urine naturally ; slept well last night ; still much languor and lassitude.

4 P.M.—Up to this hour he seemed improving ; suddenly has come on great dyspnœa ; no vomiting or purging ; places his hand on his abdomen as if it pained him, but cannot articulate.

Twenty minutes past 4.—Died in the fit of dyspnœa.

Sectio cadaveris, 18 hours after death. Dec. 19th, 1844.

Head.—Weight of cerebellum, pons, and portion of medulla oblongata, 3vi. 3iii.

Cerebrum, weight, lb.ij. 3viii. ; about 3iss. of clear serum collected in occipital cavities ; some red points on section, not many ; very little congestion of any of the vessels ; no fluid in lateral ventricles ; nothing very abnormal.

Chest.—Heart, weight, 3viii. 3i. ; left side contracted, but not strongly, containing a small polypus interlaced among columnæ carneæ, and extending along aorta for some way ; on right side walls flaccid ; a large polypus reached along both pulmonary arteries to where they plunge into the lungs : dilating at the sigmoid valves,

it had there a bulbous shape, was white and hard, and connected with intertwined polypi in the ventriele; valves perfectly healthy.

Lungs.

Right lung, weight	lb.j. 3viii. 3iv.
Cut, washed, and drained	lb.j. 3i. 3vii.
Left lung, weight	lb.j. 3iii. 3vi.
Cut, washed, and drained	3xv. 3ii.

Both lungs were somewhat collapsed: on the superior surface they were pale, oleaginous to the feel, and oedematous: they were crepitant generally, but in some parts not so. On removal, the under parts were found to be densely gorged with red, frothy, and bloody serum: there were small coagula pressed from the cut vessels. At the lower part of the right lung was a small round collection of creamy pus, about 3i. in quantity. Round this small abscess the pulmonary structure was the same as at other parts. The pulmonary structure of the lower lobes, and at intervals throughout the whole of the lungs, was, as before said, excessively distended with serum; it was red, and had something of a bruised look (though this was not universally the case); it floated in water, and nothing like the appearance of granulation or deposit of lymph could be seen. In some parts the lung was not crepitant; in others it was so. In the red parts the colour was uniform, or slightly mottled with a darker substance; there were no tubercles. The mucous membrane of the bronchial tubes was also covered with frothy serum, and was slightly reddened. No liquid

blood flowed into the thoracic cavity when the roots were cut through.

Abdomen.

Liver (gall-bladder emptied), weight... lb.ij. 3ix. 3ix.
Cut, washed, and drained..... lb.ij. 3ijj. 3vi.

Large, much congested ; large quantities of blood exuding on section after washing ; surface pale ; lobules distinct, not softened.

Gall-bladder moderately full, not distended, but large and yet flaccid ; about 3iii. of thin, olive-greenish, slightly stringy bile, staining the hands yellow. Mucous membrane of gall-bladder stained olive-green ; reticular structure distinct ; gall-duct traced into duodenum, pervious, and apparently enlarged. The large vessels of liver appeared chiefly congested ; duodenum, peritoneum, and surrounding parts, stained deeply green with bile.

Spleen.—Weight, 3iv. 3j. ; small, contracted, hard, septa very distinct ; some drops of dark blood on surface of sections.

Kidneys.

Right kidney, weight... 3v. 3v. } natural ; some little
Left " " ... 3v. 3iii. } congestion.

Stomach and small intestines.—Stomach healthy ; a little corrugated.

Small intestines.—Solitary glands throughout few ; in duodenum not seen at all ; mucous membrane darkly stained with green bile ; dark ramiform congestion and

staining in ilium ; Pcyer's glands visible in two or three places, not enlarged or inflamed.

Cæcum.—Three or four healed ulcers ; muscular fibres for floors ; puckering of edges ; one small ulcer, 1 line in diameter ; others, 2, 4, and 5 lines respectively ; colon healthy ; no enlarged glands seen.

Pancreas.—Weight, 5ii., rather red ; proper duct, when cut into, containing a rather gelatinous, yellowish, or greenish yellow transparent fluid. The blood from the heart after two hours did not coagulate further ; it looked thick ; on the sides of the vessel it had assumed a vivid arterial hue.

I have witnessed several cases nearly as severe as this one. I particularly recal to mind one case, so severe at first sight that I believed it to be the first case of an epidemic : however, the symptoms became moderated in two hours, and in eight hours the patient was convalescent.

I think, after reading these Cases, every one will be disposed to admit the difficulty, perhaps the impossibility, of drawing any valid mark of distinction between them and the epidemic disease.

If the hypothesis prove to be correct, that in Cholera there are several distinct changes in the blood, some of greater, others of less moment, it will not be difficult to conceive that all these forms of pseudo and sporadic Cholera, and even the common English Cholera in its severest forms, are allied to epidemic Cholera, inasmuch as in each there are chemical changes in the blood, similar, though not perhaps identical, with those occur-

ring in the latter disease. The great difficulty of the subject is, that it is impossible to separate the cases of choleric with some degree of coldness, from other cases without this, or even with a hot skin, but which are evidently produced by the epidemic cause, and thus, by too great a generalization, we run the risk of including under the term Cholera, diseases, characterized by symptoms totally antagonistic.

But certainly, from a consideration of symptoms alone, it is impossible to solve this difficult point. A full knowledge of the changes in the blood in each of these diseases can alone afford us a satisfactory solution.

CHAPTER IX.

ON VARIOUS POINTS NOT DISCUSSED IN THE PREVIOUS
CHAPTERS.

THERE are several points connected with Cholera, on which I have so little new to say, that I shall compress them into a very few lines.

1. I have never observed any indication of contagion. In common with the great majority of Indian writers, my evidence is on the negative side. When Cholera prevailed for months in Tenasserim, and traversed indeed the whole of Eastern Asia, I never heard human intercourse alleged as a means of introduction into any place. The Burmese and Tailiens never considered it contagious, and shewed no wish to avoid their relatives when sick, or to omit the customary ceremonies over them when dead. For months, as already said, the disease was raging in one particular part of Moulmein ; intercourse between this and other portions was certainly not in the least interrupted on that account, and yet there was no corresponding extension of the disease.

No precautions were taken to prevent the European soldiers from going into the Bazaar ; yet they were not attacked until nine months after its first appearance in the town. The sepoys of two native regiments mixed

still more freely with the natives, and yet they were untouched throughout.

In one single instance, we adopted precautionary measures. In April 1843, a small relieving detachment of 34 men was sent by the European Regiment, from Moulmein to Mergui, by sea; immediately after their arrival at Mergui, two fatal cases of Cholera occurred. The relieved detachment arrived at Moulmein five or six days after these deaths, without the occurrence of any fresh cases: it was deemed prudent, however, to put these men in quarantine three miles from the European cantonment: here they remained in perfect health, for fourteen days, and were then marched into barracks: this occurred either on the 14th or 15th of May: on the night of the 21st of May the first case of Cholera appeared: of course this was in no degree attributable to the junction of the detachment, which had seen no Cholera for twenty-five days at the very least. I mention these dates thus particularly, because a loose statement, that Cholera broke out in a regiment after the junction of a detachment which had suffered from Cholera, might be supposed to be some proof of contagion.

During the epidemic attacks in 1843 and 1845, among the Europeans, there was a large extra allowance of Hospital servants and coolies: these men were constantly in the Cholera ward, aiding the sick men in and out of bed, putting them into baths, rubbing the cramped limbs, emptying the close-stools, and performing all the offices demanded by the patients, usually so restless and fretful in the earlier period: and yet not one of these, nor any other of the Hospital servants, were

attacked. The medical officers were constantly on duty, receiving and inspecting the sick, examining the dead bodies, &c., and yet enjoyed the same immunity. In the post-mortem examinations of Cholera patients, I have accidentally inoculated myself many times without ill effects.

So also in the Jail Hospital, none of the medical men or attendants were attacked. When I was engaged in post-mortem examinations in the Jail, I employed several Hindoos to assist me, and we spent many hours every day in a temporary shed, that we used as a dead-house, and yet no one ever thought of any danger from contagion. In fact, I may sum up my own knowledge, in the assertion that I have personally never witnessed in India any fact which would have led me to believe that the poison of Cholera possessed the character of a contagious virus, viz., the power of multiplying itself by its action on the living human system. It is to be understood that I by no means wish to generalize this observation, and to conclude that the poison of Cholera is never reproduced by the human body.

2. I could obtain no very certain information regarding the period of incubation. In some cases this period is obviously very short ; as the following case seems to indicate. One evening, at Madras, an orderly corporal brought a sick man to my quarters. As it was a wet evening, I directed the corporal to put the patient in the palanquin, and send him down to the General Hospital, which is about half a mile from Fort St. George, and to return himself to barracks. Instead of doing so, however, the corporal walked by the side of

the palanquin to the Hospital, through a heavy shower, because the patient, who was in the early stage of Cholera, was nervous, and begged him to do so. When I arrived at the Hospital, I found the corporal there, and fearing some bad results from this exposure, I made some inquiries into the state of his health: he said he felt perfectly well, and that he never was better in his life. I sent him back to barracks immediately, to change his clothes. Unfortunately, during the night, from some unusual circumstances, he was out several times, and got wet again: towards morning he was purged. When he was relieved off duty, he felt ill, but did not report himself sick till 10 A.M.: at this time he was pale and faint; there was tinnitus aurium; he had vomited twice and been purged very often, and had recently passed pale urine; the skin was cool and moist; the pulse very feeble; the voice slightly altered; there was dyspnœa and tightness across the thorax. An hour afterwards he was deeply in the algide stage.

In this case there is a great probability that the exposure, and perhaps the mental depression arising from witnessing his comrade attacked by a disease so dreaded as Cholera is by our troops in India, really did render this man susceptible of the influence of the poison; if this be so, the incubative period could have lasted only a few hours.

I have not, in any case, been able to affix a longer incubative period than three, or perhaps four days, but an instance occurred in Moulmein of an apparent extension of this period to nine or ten days. I was

not personally cognizant of the case, but it was related to me, immediately after its occurrence, by a medical friend on whose correctness I place great reliance. The Burmese villagers, who deserted their homes and marched into the jungle, generally named two or three days as the time after which no fresh cases of Cholera occurred.

In the greater number of cases which I collected, no evidence could be obtained bearing on this point: very few men could state any definite and formal exposure; they generally merely said they had felt well up to a certain date, and then, without assignable cause, had noticed some of the premonitory symptoms.

3. My cases are too few to allow me to offer any definite opinion as to the mortality among those attacked, and it is obvious that the proportion varies considerably in different epidemics. Out of 80 cases of true Cholera, in adult male Europeans between the age of 20 and 40, for the correct diagnosis of which I pledge myself, the proportions are 45 deaths to 35 recoveries. These cases are taken from two epidemics, but the proportion in each epidemic differs from this standard, one falling below, and one exceeding it. Thus, in one, there were 44 cases and 19 deaths, or considerably less than one half; in the other, there were 36 cases and 26 deaths, or more than two-thirds. The cases in Asiatics, about 150 in number, give certainly a lower rate than this, but I am unable to state the exact number of deaths, as I have not preserved some of my notes.

The mortality assigned above to the Europeans,

viz. $\frac{9}{16}$, or about 56 per cent., is much greater than is generally calculated from the official returns. This arises partly from the fact that in the official returns many of the anomalous pseudo cases are necessarily returned under the head of Cholera; in fact, as they can come in nowhere else, their addition swells considerably the list of recoveries. I am certain that in one epidemic which I witnessed, the inclusion of these cases would have doubled the return, and given an immense but fallacious preponderance to the cures.

At the same time, I am far from believing that this great mortality of 56 per cent. is true for all epidemics; the average of the whole must, I am certain, be much below this. Otherwise we cannot account for the astonishing success which attended the practice of several gentlemen in the earlier periods in India. One gentleman saved 98 out of 100; another 88 out of 90. And although it is obvious that, in some of these cases, those cured were of simple pseudo Cholera, with a full pulse and a warm skin, yet, in other examples, it must be concluded that the cases were really authentic examples of the algide Cholera; and yet the mortality was not more than between 25 to 35 per cent. I therefore conclude that the epidemics I witnessed were above the ordinary degree of severity, and the mortality proportionably great.

4. Another question which I am equally unable to answer, refers to the nature of the predisposition or habit of body which enables the choleraic virus to act. In my post-mortem examinations, I constantly endeavoured to find some indication of a common

antecedent disease, but without effect. And among the Europeans, although I was personally cognizant of the state of health of many of them, I never could form even a conjecture as to the condition of body which was most favourable to the attack of the disease.

An observation which I find recorded in my notes of 1843, possesses some interest. I find it noted that in several cases in Asiatics there was a greater or less degree of pulmonary emphysema. Now this disease is certainly uncommon in Asiatics, who are little subject to bronchitis, and I thought the repeated occurrence of this pathological state somewhat remarkable. But these observations were often hurriedly made, and not to be depended upon; and, from the analysis of the more accurate post-mortem examinations on which this treatise is founded, it appears that pulmonary emphysema is not so often present as I at one time supposed. Moreover, among the Europeans, who were young and vigorous men in the prime of life, and never subjected to any pulmonary complaint, emphysema was certainly seldom found; its presence, indeed, was not to be expected.

It is, however, a curious coincidence, that Jackson should have noticed in Paris, in 1832, the occurrence of emphysema in no less than 8 cases out of 25 in persons dying without reaction.*

* Jackson on Cholera in Paris. Boston, 1832.

In this work there are recorded, altogether, 26 dissections of persons of both sexes dying in the acute stage. In one of these the thoracic organs are left unnoticed. The cases in which em-

This observation, with which I was totally unacquainted in 1843, has certainly a singular accordance with my remark. Perhaps some peculiar disease of the lungs or heart, yet to be discovered, may in some way influence the respiratory process, and therefore assist the action of the poison on the blood in the lung. I never could discover any antecedent disease of the heart, although my attention was particularly directed to this organ, in consequence of the well-known opinions of Dr. Mackintosh.

Certainly there is a peculiar constitution, or perhaps condition, of the blood, which predisposes to Cholera.

physema, more or less general, was noticed, are numbered, 7, 11, 19, 20, 21, 24, 25, and 27. Cases 28 and 29 were not examined. It is worthy of remark, that the state of the lungs and heart are very cursorily described in the earlier post-mortem examinations, while towards the end of the epidemic a much greater space is given to the description of these organs. Of the eight cases of emphysema, six are in bodies examined in the latter period, so that it may be supposed that some cases of emphysema were overlooked in the earlier period.

In connection with the subject, I may mention that in twenty cases in Europeans, Dr. Morehead, of Bombay, found more or less extent of emphysema in seven.—*Bombay Transactions*, 1844, pages 80—90.

According to these observations, therefore, in 45 dissections, there were 15 cases of emphysema, or exactly one-third. The addition of my own observations reduces the number to nearly one-fourth. But still this is a great number, when it is remembered that both my cases and those of Dr. Morehead were in young Europeans. The average age of Dr. Morehead's patients was rather more than 27 years.

The following case seems to prove this. In 1843, a soldier was admitted with slight, but well-marked, symptoms of algide Cholera, from which he rallied without consecutive fever. In 1845, this man was apparently in perfect health : he was stout and robust, of remarkably quiet habits, and a teetotaller. He was the second man in the Regiment who was attacked with the disease, and immediately recognized the nature of the complaint, from his recollection of the symptoms he had experienced two years before. Now in this case, which proved fatal, was there not some peculiar condition of body, which rendered this man more obnoxious than almost any other of the 1000 men in the same Regiment to the action of the virus ? The case also furnishes the only instance which has fallen within my own knowledge, of the occurrence of the disease twice in the same individual.

I have seen two men attacked with Cholera, while suffering from tolerably severe ptyalism. Dysentery and common bowel complaints, not attributable to the epidemic constitution, and malarious fevers, did not appear to predispose to Cholera. The epidemic constitution, however, seemed, in 1843, to give a choleroïd character to the evacuations, both in remittent fever with diarrhoea, and in malarious dysentery.

The state of health previous to the attack of Cholera varied exceedingly : in some cases the Europeans stated that they had never felt better in their lives than before the attack ; in other cases the men had been sickly. It is, however, a remarkable fact, that, both in 1843 and in 1845, the per-centages of the men attacked in hospital

was not above the average in the Regiment generally, and yet, of course, these were men reduced greatly in strength and flesh, from various diseases. And I may say here, that I have met with several surgeons in India who thought they had observed the most healthy to be the most obnoxious to Cholera. I believe the fact to be, that common debility is not a great predisposing cause, nor is robust health an effectual safeguard. The peculiar predisposition is independent of these circumstances.

CHAPTER X.

TREATMENT OF CHOLERA.

THE great difficulty in the treatment of Cholera, and the cause of the contradictory and opposing statements which have been made respecting the value of particular medicines, is to be found in the peculiar action of the choleraic poison. This action, by arresting the circulation, and thereby rendering absorption difficult, opposes itself to the common method of administering remedies. After a certain period of the disease, medicines remain in the stomach, and do not pass into the circulation, or do so with great difficulty and slowness. At least this is to be inferred, both from the circumstance that in the advanced stage, calomel, acetate of lead, creosote, opium, turpentine, &c. have been found in the stomach hours after they have been taken, and that fluids taken to appease thirst, remain in and distend the stomach, if they are not vomited, and also from the evident languor and delay of the circulation,—states which are considered unfavourable for absorption.

The treatment of algide Cholera naturally therefore divides itself into two parts, according as it is applied in the earlier period, while circulation still goes on with sufficient vigour to allow of absorption, and according as it is used after this period, when,

from the arrest of the circulation, absorption is prevented, and it becomes useless to pour drugs into the stomach.

It is also tolerably evident, that for practical purposes there are two aspects under which every case of Cholera, except the most malignant, must be viewed. These different points of view refer—1st, to the watery exhalation, and 2d, to the deeper changes in the proteine constituents, as opposed to each other. Therefore, in the treatment of most cases of Cholera, two indications have been generally followed; and remedies have been given either for the purpose of arresting the watery purging, or of acting directly upon the latent changes in the blood which constitute the essence of the disease.

Many of the apparent contradictions in the modes of treatment recommended by authors, are readily explained, when the pathology of the disease is remembered. Thus astringents have been found highly useful by those who have witnessed chiefly the slighter forms, in which the changes in the fibrine are moderate in intensity, and capable of gradual reparation when the exhalation of serosity is arrested. Emetics and purgatives have been extolled by other observers, who have encountered the severest types, and who, recognising the comparatively slight character of the cases with great purging, believed that the chief indication was to bring on this symptom in the cases under their treatment.

It may, I think, be satisfactorily proved, that the arrest of the watery elimination, in the cases of inferior

intensity, is attended, on the whole, by positive and undeniable benefit. This is most unequivocally shewn by observing the progress of cases left altogether to nature. The earlier writers in the Bombay and Madras Reports, state, as an invariable rule, that the vast majority of untreated cases died. In 1843, I witnessed several cases in Hindoos who absolutely refused to take medicine: in these instances, cases, which as far as could be known, otherwise offered fair chances of recovery, proved rapidly fatal; and it appeared to me, that the unchecked watery purging, as might have been anticipated, predisposed to those further more important changes in the blood, which the choleraic poison had not been sufficiently powerful or intense to produce at once. If the watery purging had then been stopped, these further changes might not have proceeded to their full extent, but might have occurred in a lesser degree, and have been divested of their fatal and uncontrollable character. This inference is corroborated by watching the method of cure in Europeans actively treated: in these cases it is invariably found that remedies have partially or altogether arrested the purging. Coincident with this, the changes in the proteine constituents have become stationary for a variable time, and have then slowly repaired themselves. The opinion held by some writers, that the vomiting and purging are salutary evacuations, is doubtless erroneous, and arises simply, as already stated, from the fact that the supervention of these symptoms in the severer cases is a favourable circumstance, as arguing renewed activity of circulation.

I am far from intending to assert, however, that the arrest of the watery purging is synonymous with the cure of Cholera ; this is unfortunately contradicted by daily experience. Every one must have seen cases in which the purging was arrested with comparative ease, and yet the fatal algide symptoms were not in the least affected thereby. I merely assert, that observation will prove that nature may be assisted in restraining or in repairing the primary changes in the blood, by removing those earlier, slighter, and non-essential symptoms, which appear to have so much influence, in certain cases, in inducing, or in increasing, the essential and fundamental alterations.

But if the medical art has been of decided benefit, when employed according to this indication, it must be confessed that it has hitherto failed to accomplish the other more important indication, of arresting or controlling the essential alterations in the blood. No medicine has yet been found which can counteract the changes in the fibrine, and nullify the first effect of the choleraic virus in the blood. The antidote to this tremendous poison has not yet been discovered, and the resources of modern European science have opposed its destructive action with as little effect, as the untutored efforts of the most barbarous nation to whom its ravages are known. The efforts of European science have indeed, it appears to me, in many cases proved hurtful. The attempt to cut short the disease, and to rouse the system from a state erroneously compared to debility and to exhaustion, has certainly often accelerated the progress of Cholera. It is a most important practical

point, that Cholera runs a certain course : when the algide symptoms have once shewn themselves, a ease cannot be cut short : even in the mildest forms, warmth does not return altogether for a long time, but when the disease has reached its aeme the patient is invariably seen to remain for some hours in a peculiar state, during which time Nature seems to be gradually repairing the injury which has been done. Therefore, when a person is cold and almost pulseless, with a heart embarrassed and a respiration nearly arrested, the attempt violently to rouse him from this state by strong stimulants, by warmth to the surfacee, by continued frictions, or by measures of a like kind, seems to me to be founded altogether on a misapprehension. Before the delicate machinery of circulation and respiration can again play, hours must elapse ; if medicine could only keep the patient alive for these few hours, all would be done that art can ever do. If respiration could be maintained—not the mere mechanicl act of breathing in and out, but the ehemical proeess in sufficient integrity to allow the blood to eirculate through the capillaries of the lungs—nature would gradually bring about the cure. This is the great problem which medieine has to aecomplish, and which, next to the discovery of some actual antidote to the poison itself, appears to be the most ready method of aecomplishing the cure of Cholera.

The treatment of Cholera, therefore, naturally divides itself into two periods, each having a double signification. In the first period, absorption is possible, and serosity is eliminated. In the seeond period, absorption is, to a greater or less degree, arrested, and there

is comparatively little purging. A certain number of cases of the greatest degree of severity will present themselves only during this second period, and these are the cases which are almost inevitably fatal.

I.—*Treatment of a case of Cholera in the first period, while absorption is possible.*

The great indication in this period is to prevent the passage of fluid from the alimentary mucous membrane and from the skin.

The two grand measures, which, in my cases, seemed best to arrest the watery purging and the sweating, were blood-letting and astringents. In addition, a strong stimulus at the very commencement of this stage was certainly found to be occasionally useful.

Blood-letting was strongly recommended by several of the early reporters in India. Annesley, also, esteemed it so highly, that he calls it "the sheet anchor." Twining, who saw a much more severe variety of Cholera than Annesley, found it comparatively useless.

On looking over my cases, I find it impossible to give any numerical statement which shall convey a just idea of the value of blood-letting. I have seen twenty-four adult male Europeans bled freely, and of these only five died: but then these twenty-four were all slight cases—many of them were admitted in an early stage, and they were all subjected to active treatment of other kinds. I have seen fifty-six adult male Europeans not bled, and of these forty died; but then these were all severe cases, many of them were in reality dead when they entered the Hospital, and it

would be in the highest degree unphilosophical to attribute their deaths to the want of bleeding. I never saw any Asiatic bled, and yet the mortality was certainly not greater than among the Europeans. The numerical method cannot be applied to the treatment of a disease like Cholera, which runs so rapid a course, while it is treated by such a variety of remedies. I shall therefore not attempt it in any case, but shall merely give the general results of my observation, which, if it be confessedly a loose and inaccurate method, is not so likely on the present occasion to lead to erroneous conclusions.

The benefit resulting from blood-letting was generally more marked according as the disease was in its earliest stage, and according as it tended towards the several varieties of pseudo Cholera. In these latter cases the employment of blood-letting was sometimes followed by very striking results, particularly in those cases attended by a full pulse, and severe general spasms. For example, I saw a stout European soldier one hour after admission into hospital : he was violently purged and vomited, and was labouring under the most severe and frightful spasms. They were general and quite tetanic in character ; the pulse was hard and sharp ; the skin warm. He had been treated with calomel and opium without benefit. I immediately opened a vein, and took away forty ounces of blood before the spasms ceased. I then gave him Tinct. Opii, 3*j.* and repeated it in an hour. The pulse immediately after the bleeding became fuller and less resisting, the vomiting, purging, and spasms ceased, a gentle perspiration appeared on the skin, and he recovered

without another symptom of any kind. It was the most striking instance I ever saw of pseudo Cholera being cut short. There can be little doubt that it was the successful treatment of cases of this kind which led Corbyn to attach too high a value to his plan of bleeding, followed by large doses of calomel, opium, and oil of peppermint.

Sometimes, in the early stage of Cholera, the blood became lighter in colour as it flowed, so that in addition to arresting the purging, blood-letting has probably some effect in relieving the oppressed heart and lungs.

I do not know how to account for the efficacy of blood-letting, unless it relieves congestion to some extent, and also produces a beneficial effect by removing a portion of the vitiated circulating fluid.

Of all the astringents which have been used in Cholera, none has appeared to me so efficacious as the one recommended by Dr. Graves, viz. the acetate of lead. It is true that it did not arrest the purging in all cases, but it possessed this great advantage, that in the form of pill with opium, it did not seem to increase the irritability of the stomach, but rather to allay it. I used to give two or three grains with a quarter of a grain of opium, every half hour for the first two or three hours, and then every hour for a variable period according to the intensity of the case. It was often found that the vomiting first ceased, and then the purging ; the algide symptoms were of course unaltered, but, as already said, no remedy yet known possesses any influence over them, and it is the best way to leave them altogether to themselves, and take the

chance of their not advancing to thcir full extent. Thc only bad effect I ever noticed after the employ-
ment of thcse large doses of lead, was subacute gas-
tritis ; but this is a comparatively trifling affair, and can
generally be overcome by relays of leeches to the
epigastrium during the period of reaction.

The sulphate of copper and of zinc seemed also occasionally to restrain the purging ; but these remedies are not so readily borne by the stomach, and are ther-
fore inferior in practical value to the acetate of lead.

Small doses of calomel and opium seemed some-
times to stop the purging, and whenever I found these
remedies undoubtedly serviceable, it was by their action
in this way ; calomel at other times secmed not to do
good, and even to do harm.

Many other astringents, as kino, catechu, alum with
hemp, opium and camphor, chalk, &c. were sometimes
useful.

The acetate of lead, or the other astringents, often arrested the vomiting as well as the purging ; but in addition I have seen innumerable plans tried to mitigate this distressing symptom. Mustard poultices to the epigastrium, small doses of opium, creosote, musk, or trisnitrate of bismuth, wcre the measures I found most useful.

The cramps which attend this period werc relieved most readily by friction with opium, turpentine, or olive oil and ammonia : warm fomentations werc also occasionally uscful.

It is of course understood, that the acetate of lead and all other remedies will occasionally prove quite

useless, and fail altogether to arrest the vomiting and purging: other remedies must then be tried, but I need not occupy space by enumerating these; they have been fully discussed by several standard authors.

The second indication during this period is to counteract the deeper and more important changes in the blood.

The list of remedies which have been used in Cholera with this indication, comprises all the stronger medicines known to physicians at the present day, and, as it appears to me, no one medicine has been found more uniformly efficacious than another. The occasional mildness of an epidemic, or the use of a medicine towards its close, when the cases are less severe, have indeed conferred a temporary repute on certain remedies, but the next epidemic has invariably shewn the boasted specific to be in reality as useless as any other, in the long array of medicines which have had an equally undeserved and equally transient popularity.

In the epidemics which I witnessed, I had an opportunity of trying myself, or of seeing tried by others, a variety of plans, and I shall now proceed very cursorily to give the general results of my observation.

1. *Applications to the surface, warm and cold baths, &c.*

Warm-baths, vapour-baths, and warmth applied in any way to the surface, never appeared to me to be of the slightest service in true Cholera. The spasms were sometimes relieved, but the algide symptoms were almost invariably increased. The depressing effects of

the warm-bath were sometimes marked and unmistakeable. I have seen a man walk firmly to the bath, with a pulse of tolerable volume, and a cool but not cold surface, and in five or ten minutes have seen the same man carried from the bath, with a pulse almost imperceptible, and a cold and clammy skin. I cannot find in my notes a single case in which the warm-bath appeared beneficial. It is, indeed, unlikely that the attempt to restore warmth by these trifling means, when the grand source of animal heat is so fatally disordered, can ever be successful. Several writers have also recorded their belief in the inutility of this measure.

In very slight cases, however, and in pseudo Cholera, the warm bath was grateful to the patient, and was not attended with any perceptible bad effects ; in those comparatively unimportant cases, attended by violent spasms, it was certainly and positively beneficial. If warmth is used at all, I think it should be only during the earlier periods of the case, and, as recommended by Dr. Copland, it should be in the form of the hot-air bath.

Stimulating frictions, blisters, escharotics of all kinds, were also decidedly unproductive of benefit, except in so far as they allayed spasm—no effect was ever produced upon the algide symptoms. I perhaps should except large mustard poultices, which were considered serviceable by several medical men for whom I have a great respect. I never knew them do harm, and therefore I presume it is right to employ them for the chance of benefit.

Cold to the surface was a measure much more

grateful to the patients than warmth. This might have been anticipated also from the way in which the bed-clothes are thrown off, so as to expose the surface freely to the air. The cold affusion, even in the last stage, two or three hours before death, sometimes caused the pulse to become again perceptible. Perhaps the application of cold to the surface may affect the respiration in some way; the gasping inspiration which the shock of the falling water generally induces, may influence the circulation in the lungs, like the first impression of the cold air on the body of the newly-born infant. But, unfortunately, after a short time, the reviving effects of the cold affusion disappear, and the ease resumes its former course. The use of large fans and punkahs causing a blast of air upon the body, seemed to me to be occasionally useful, and to be generally agreeable to the patient.

2. *Remedies taken by the mouth.*

I believe my assertion that no remedy is more useful than another, in fulfilling the present indication, will be agreed to by every one. I gave, in a variety of ways, and in all stages, calomel, opium, hemp, camphor, quinine, creosote, tartar emetic with and without opium, salines of all kinds, ether, hyoscyamus, and, in fact, every medicine which could be obtained. Large doses of calomel, such as 15 or 20 grs., were given in many cases, certainly without benefit, perhaps even with positive injury. I observed in several cases that when calomel was given in large doses, or in small doses frequently repeated, at the time when absorption

was possible, the algide symptoms seemed to be increased. I do not wish to attach any weight to this observation—it was perhaps an error: calomel and opium were largely used in England in 1831-2, and were considered beneficial, although certainly the arrest of the vomiting and purging which small doses of calomel and opium occasionally accomplish, may have led to the belief that the disease itself had been checked by the mercury.

If there was little vomiting, it appeared to me that the use of diffusible and aromatic stimuli, and of small quantities of champagne or spirits, was useful. But decidedly, the employment of stimulants for the purpose of arresting the disease and of rousing the patient, was quite useless, and, indeed, hurtful.

3. Remedies employed in the form of enemata.

I used largely at one time warm saline enemata, after the manner of Stevens. They certainly did not do harm, but I could perceive no unequivocal marks of benefit. I have met, however, with several Indian practitioners who thought them useful in the early stages and the milder cases.

4. Remedies inhaled into the lungs.

I employed in several cases the vapours of ether, ammonia, creosote, alcohol, and iodine. Chlorine I used in one or two cases. I should have used oxygen if there had been time or apparatus to prepare it. I

employed artificial inflation in a few instances, but soon abandoned it as being quite useless.

The only vapours about which I consider I can speak positively from my own observation, are ammonia and creosote. The ether and the alcohol were not given in sufficient quantities, nor with an apparatus sufficiently good to throw large volumes into the lungs. It remains to be seen whether the employment of large quantities of ether, such as are used to procure insensibility during operations, may not be useful.

There are great difficulties in the employment of inhalation. The dyspnoea is often sufficient to prevent the patient from using the apparatus, and the constant restlessness and jaetitation are of course unfavourable for its employment. However, in two cases in European soldiers, men of great moral courage and endurance, the ammoniaal vapour was fully tried : in one of these cases, no perceptible effect was produced either on the pulse or on the skin ; in the other case the patient stated that the vapour eased the painful dyspnoea and thoracic oppression ; no effect, however, was produced on the pulse. Both these cases were as rapidly fatal as the other cases occurring at the same period of the epidemic. One of these men was in addition treated with calomel, opium, and small quantities of brandy ; the other with acetate of lead.

The ammoniacal vapour was employed in several other cases at intervals, but without apparent effect. The same remark must also be made of the vapour of creosote.

It appears, therefore, that so far as my observations

go, they are not favourable to the practice of inhaling. It must be said, however, that my experience of this plan was comparatively limited. I believe I am correct also in stating that the inhalation of various vapours has been used by several gentlemen in India without marked effect.

5. *Employment of currents of galvanism, passed through the chest, or from the neck in the direction of the eighth pair of nerves.*

I merely enumerate this practice, as one which has been used in India as well as in Europe by several individuals apparently without any good result. I have never myself had the opportunity of employing it.

The conclusions arrived at, as to the indications of treatment in this early stage of Cholera, are, then, shortly these:—

1. The use of bloodletting and astringents to arrest the passage of fluid from the alimentary mucous membrane.
2. Mustard poultices to the abdomen and cardiac region.
3. The cold affusion, and cold to the surface generally; cold drinks are also grateful, and should be freely allowed, if they do not produce vomiting.
4. Diffusible stimuli, provided vomiting is not reinduced.

When the vomiting and purging have been stopped, time must be given for the function of respiration

to be again properly performed. During this time the patient should not be too actively treated; our knowledge is not sufficiently advanced to allow of any undue interference with nature. If, as occasionally happens, the algide symptoms increase after the arrest of the abdominal symptoms, the case passes into the second category, which I have now to consider.

II.—Treatment of a case of Cholera in the second period, when absorption is very slow, or is completely stopped, and when, consequently, the common modes of giving medicines by the mouth or anus are useless.

At the commencement of an epidemic some cases are generally admitted with symptoms so intense as to bring them at once into this period, or a case may gradually merge from the first into the second period.

At this time the exhibition of medicines by the mouth or anus is perfectly useless, unless they are intended merely to have a local effect on the muscular fibres of the tube—such as emetics or purgative enemata. The only means by which medicines can be introduced into the system are by inhalation into the lungs, or by injection into the veins. Certain other remedies have been recommended in this stage, such as bloodletting and emetics.

1. Bloodletting has been strongly recommended by several writers in this stage. The opinion of the majority is, however, against it. It is difficult, indeed, to conceive, that removing any portion of the blood can

sufficiently affect the real seat of the disease in the lungs. It has been stated that the blood becomes lighter in colour as the blood flows, indicating the partial re-establishment of the respiratory function. This, I must confess, I have not seen in this stage, and it is possible that reference may have been made only to the earlier period. It is exceedingly difficult to get blood in this period; the blood flows guttatum, and the arm must be fomented sometimes to obtain the blood even in drops. If, however, bloodletting does little good, I do not think it does any harm, and occasionally it seems to relieve the painful dyspnœa and oppression at the heart. Thus, in 1843, I saw a stout European, about forty years of age, fourteen hours after the commencement of his attack. He stated that the invasion was sudden, and without premonitory symptoms. He reckoned the number of stools at about forty or fifty. When I saw him he was deeply in the collapsed stage; the lips and skin were very cold and livid; the fingers corrugated; there were cold clammy sweats; the eyes were sunken, the cornæ flaccid, and the areolæ were livid and large. The voice was whispering; the pulse at the wrist was imperceptible; the breathing costal, shallow, yet laborious; there was great muscular weakness, and he was unable almost to move himself. The most distressing symptom was an intolerable constriction and tightness across the chest, and an intense weight and oppression at the heart. Vomiting and purging had nearly ceased, and the cramps had become very slight and infrequent. As I believed this case to be inevitably

fatal, and as the thoracic oppression was of a most agonizing kind, I thought there could be no harm in trying to relieve it by bloodletting. With much difficulty, and drop by drop, about $\frac{3}{4}$ pdr. of blood were taken away. The patient immediately felt easier; the constricted feeling across the chest for a time almost disappeared, and the pulse at the wrist became perceptible. He now begged to be allowed the cold affusion, and on the bath being brought into the room, he got out of bed without assistance, sat down in the bath, and rubbed himself with many expressions of pleasure, as the cold water was poured over him. After getting into bed, he said he felt perfectly well, and had lost all pain in the chest. In less than half an hour, however, the cardiac oppression began to return, and shortly became as distressing as before. He was now dry cupped on the chest with some slight relief, but the algide symptoms increased, and he became comatose. He died in six hours after the bleeding, which was about the time I should have conjectured he would have lived if nothing had been done.

2. Emetics have been much recommended, as having a tendency to restore the circulation by the shock they give to the system. I used emetics of ipecacuanha and mustard, but I have never observed much benefit from their use.

3. I tried the inhalation of various vapours in this stage as well as in the other period, and with the same want of success. The insufferable dyspnœa is almost a bar in many cases to the employment of measures of this kind. The best way would be to diffuse the vapour

through the room, and impregnate the atmospheric air as strongly as can be borne by the attendants. Chlorine might be used in this way, and perhaps iodine. I do not, however, feel sanguine as to the good effects of any of these remedies.

4. When a case has reached the second period, it is almost inevitably fatal. Occasionally a patient rallies after many hours of apparently almost suspended circulation, but this chance is hardly worth anything. And yet, if the circulation could be partially kept up, every hour makes that chance greater; if any means could be devised to restore in some part the process of respiration, nature might overcome the chemical combination which the poison has formed with some ingredient of the blood. This great result, the problem in the treatment of Cholera, can only be accomplished by injections into the veins; for it is at this time useless to attempt the absorption of medicines through the alimentary mucous membrane or the skin, and also it appears through the bronchial mucous membrane. The only available plan is, if possible, to throw the drug into the circulation. Transfusion was resorted to in 1831-2 to restore the blood, which was supposed to have drained off, but apparently with little success; and this is not to be wondered at, when it is evident that the disease is owing to vitiation, and not to want, of blood. The saline injections used by Mackintosh and others, however striking their first effects were, do not seem, from the published accounts, to have been very successful; and in some cases, which I witnessed in India, I did not even see the temporary vivifying

effects which generally followed the employment of these injections in Edinburgh.

After I had convinced myself that saline injections were not to be depended upon, I determined to try some other agent. I still thought that alkalies and salines seemed indicated by the evident occasional escape of the water and salts of the blood, and I fancied some benefit might result from an attempt to supply to the system a proteine compound ; although, of course, I could form no conception of the probable mode in which such an addition could prove useful. I determined, therefore, to inject into the veins an alkaline solution of albumen. I shall now detail, as briefly as the subject will permit, the few cases in which these injections were used. In all these cases I believed the patients to be doomed to an inevitable death. I did not consider myself authorized to try an experiment of so serious a nature, on any man, while there yet remained a chance of his rallying under the ordinary treatment. Consequently, I must premise the plan was tried under the most unfavourable circumstances.

OBSERVATION I.

An European soldier, aet. 33, was admitted at 7 A.M. having been ill twenty-four hours. He was treated with calomel and opium, followed by small doses of opium and creosote. The symptoms were of the severest kind, and at 10 o'clock, three hours after admission, the case was hopeless. At this time there were profuse clammy sweats on the forehead ; the

tongue and breath were cold; the extremities were icy cold. There was no pulse at the wrist; the voice was a whisper; the respiration was hurried and costal; the visage deeply choleraic: the vomiting and purging seemed to have ceased; and there were only trifling cramps still occasionally felt in the legs.

At half-past 12 the same symptoms continued, except that the pulse could be occasionally felt fluttering at the wrist. The skin was very cold, and the fingers and toes corrugated; the eyes were completely sunken; the voice a whisper. There had been no more vomiting or purging. Four and a half pints of the following solution had been prepared:—Sesqui-carbonate of soda, four drachms; chloride of sodium, two drachms; the albumen of one egg; and four pints of water at a temperature of 98° Fahr.

The flakes of coagulated albumen were separated by filtration, and the fluid was then slowly injected. No pain was felt when the incision was made over the median-basilic vein: the skin seemed to have lost its sensibility. The injection was finished at five minutes to 1, having occupied twenty-five minutes. During the operation the pulse rose slightly; the patient vomited once a fluid of a brownish colour; he said he had an inclination to go to stool, but was able to restrain it: the voice decidedly improved. Five minutes after the operation, at 1 o'clock, he complained suddenly of feeling very cold: at this time the skin of the head and trunk began to get warm. A few minutes after the first sensation of cold a violent rigor came on; the skin of the trunk became warmer; the skin of

the extremities became warm ; the pulse remained perceptible and regular : he begged earnestly to be covered with blankets, and hot bottles were applied to the feet.

At half-past 1 P.M. the rigor was still continuing ; it was exceedingly severe ; the teeth chattered ; the limbs trembled violently ; the bed shook, and the attempt to feel the pulse distressed the patient exceedingly, because some of the clothes were necessarily disturbed. The skin continued warm all over the body ; the pulse was rapid, but exceedingly feeble ; the voice remained very strong, and nearly natural ; the tongue had lost the icy coldness it had, and was moderately warm ; the breath was warm.

Draughts of ammonia were now given and were retained.

At 25 minutes to 2 P.M. he passed into the bed-pan a stool, watery, and with abundance of flocculi : he tried also to pass urine into the urinal, but could not do so. The rigor still continued.

At 20 minutes to 2 the rigor appeared to be subsiding ; he got out of bed for the purpose of passing urine ; he could not do so, however, but passed a small white-coloured stool, about $\frac{3}{4}$ j. in quantity : while on the close-stool he had a fainting fit, with momentary slight convulsions. On being removed to bed he regained his consciousness : the pulse was very feeble, and at times hardly perceptible. The skin continued warm ; the voice good : he said he felt very drowsy.

At 15 minutes to 2 he passed a flocculent stool into

the bed-pan : he felt an intense desire to pass urine, but could not do so.

At 10 minutes to 2 the rigor had entirely subsided. He now said he felt hot, and short of breath, and removed the bed-clothes. The respirations were eostal, thirty per minute ; the skin was warm ; the voice nearly natural. The pulse at the wrist had again beeome almost impereceptible.

At 2 o'eloek it was discovered that the exertion of getting out of bed had disturbed the bandage, and that he had lost some blood, estimated at about 3vij. in quantity.

At 5 minutes past 2 he got out of bed, and passed 3j. of pale yellow, perfectly transparent urine.

At 20 minutes past 2 the skin was again becoming eold ; the tongue was eold ; the lips were again dark ; and the voiee, as before, low and husky.

At 25 minutes past 2 he had a seanty conjee-water stool ; he was restless ; the pulse at the wrist was absolutely imperceptible. The report states that he “is now nearly in the state he was before the injection into the veins.”

At 3 o'eloek he beeame very restless ; the dyspnœa was exeeessive ; the intellect was perfectly clear.

At 20 minutes past 3 he rose suddenly in bed, then fell baek on the pillow as if fainting, and died instan-taneously.

I subjoin the post-mortem examination of the heart and lungs.

Sectio Cadaveris, one hour after death.

Lungs—Right, weight $\frac{3}{4}$ lb.; left, weight $\frac{3}{4}$ lb.

Both lungs were completely collapsed upon the vertebral column, were totally devoid of air, non-crepitant, and had an oleaginous feel: they pitted on pressure. The right lung presented this appearance in a very marked degree. On section it was pale, but became red on exposure to the air; it exuded no blood and no serum; the lower lobe was denser, and firmer, of a red colour, and contained a small quantity of frothy serum; it was as devoid of air as the rest of the lung, and presented somewhat of a hepatized appearance. The left lung was universally pale, firm, and had a rather leathery feel; there was no blood or serum in its texture; the cut surface became red when it was exposed to the air.

Each lung was incised and forcibly drained; they were then soaked in water, and again drained. The right lung gained $\frac{3}{4}$ lb., and the left lung $\frac{3}{4}$ lb. $\frac{3}{4}$ v. in weight.

The bronchial mucous membrane was pale.

Two ounces of blood slowly drained from the root of the left, and half an ounce from the root of the right lung. About two pints of blood were collected from the deep cervical veins. In an hour's time none of these portions of blood had coagulated, but had deposited a thick substratum of dark colouring matter.

Heart.—Weight $\frac{3}{4}$ oz. On opening the heart all the cavities were flaccid, and no contraction could be excited by mechanical irritation. In 20 minutes the

left ventricle had contracted to the utmost—its walls were from nine lines to an inch in thickness. The valves and substance of the heart appeared healthy; there was no blood in any of the cavities.

The other organs presented the appearances usual in Cholera. There was some clotted substance in the intestinal canal, but the quantity is not noted.

At the time of the commencement of the operation I thought the probable term of the man's life was perhaps three or four hours—he lived $3\frac{1}{2}$ hours; so that I conclude that the operation neither retarded nor accelerated death.

The unfortunate issue of this case did not much discourage me. I attributed the result in part to the accidental loss of blood from the slipping of the bandage. The return of warmth proved that respiration had been in part restored, and the violent rigor, although an unexpected symptom, was not one which I much disliked. So great was its resemblance to the cold stage of ague, that I actually thought that a hot stage might succeed it.

OBSERVATION II.

An English soldier, æt. 38. Admitted 3 A.M. July 24th, having been ill about nine hours. The algic symptoms were well marked: violent cramps came on a few minutes after he entered the hospital.

At half-past 7 A.M. he was considered to be past recovery. The surface, tongue, and breath were cold;

the pulse at the wrist was imperceptible ; the voice was low ; the respiratory murmur was roughened and shortened : the sounds of the heart feeble and low ; the lips were livid ; the eyes sunken ; the scleroticae injected ; the cramps were slight and occasional.

At 8 o'clock, the symptoms appearing to be still increasing, the following solution was injected into the veins :—Sesquicarbonate of soda, four drachms ; chloride of sodium, two drachms ; the albumen of two eggs ; tepid water, five pints and a half.

The operation occupied 15 minutes. During the operation he vomited about 3xij. of fluid ; the pulse became perceptible ; then rose to 72 pulsations per minute, and became fuller : at the end of the operation it had risen to 108, and had become feeble. Ten minutes after the arm was tied up a violent rigor came on : the man called to me to say he was about to have a fit of ague, from which he had suffered in the West Indies : the teeth chattered ; the limbs trembled ; the whole body, in fact, shook violently. During the rigor the pulse fell, and at 25 minutes to 9 it was imperceptible ; the skin, however, became warm, but not hot ; the tongue continued cold ; the voice, which had improved during the operation, again became low ; the respiration, however, seemed easier. About this time he vomited again about 3ij. of fluid ; there was no stool ; there was great thirst.

At 20 minutes to 9 the surface of the body was much warmer, but the pulse was still imperceptible at the wrist ; he appeared very drowsy ; the thirst was not so great.

At 10 minutes to 9 the rigor began to subside ; the skin was warm ; the pulse became perceptible at the wrist—106.

At 15 minutes past 9 the rigor had completely gone off ; the skin was warm all over the body, but the surface was still very dark ; the pulse continued perceptible at the wrist ; the tongue remained cold ; he was very drowsy, lying in a semi-comatose state, and moaning : when roused, he said he had no pain or uneasiness, and that he could breathe much more easily than before the operation. He had had no cramps or stool since 8 o'clock.

Draughts of ammonia were now given.

At half-past 9 the pulse was again imperceptible ; the respirations were 32 per minute, and costal.

At 10 o'clock the skin was again becoming cold ; the pulse was still imperceptible ; he was very drowsy, and vomited after drinking some water.

At half-past 10, three pints and a half more of the alkaline albuminous solution were injected into the veins ; the pulse immediately rose ; he became very restless, thirsty, and uneasy ; the temporal veins swelled ; the face became flushed and red, and the skin all over the body again warm. He got out to the close-stool, but fainted. On being placed in the horizontal position he immediately recovered ; the appearance of congestion about the head increased ; the Cholera visage completely disappeared ; the pulse, however, began to fall again ; the skin continued perfectly warm.

At 5 minutes to 11 the pulse was again imperceptible ; he was very drowsy and inattentive.

At 15 minutes to 12 no alteration had occurred : he was very drowsy, almost comatose, but when roused was perfectly sensible, and said he felt easy. The pulse could now again be felt fluttering at the wrist ; thin fluid blood began to ooze from the gums and tongue.

At 12 he vomited a small quantity of fluid, and became again very restless ; the bloody oozing from the gums ceased.

At 1 o'clock P.M. the extremities had again become cold.

At 2 P.M. he was still restless ; respirations 40 per minute, costal, and very laborious ; the extremities were very cold : he had one watery, light-coloured, but not flocculent stool.

At 3 o'clock there was less restlessness. The skin was cold, and covered with profuse but not clammy perspiration ; the tongue and breath were cold ; the voice husky, but more natural than it had been ; the pulse was imperceptible at the wrist ; the breathing was laborious, but shallow and costal ; the inspiration was less rapid, but was still shortened, and, as it were, arrested ; the expiratory murmur could be heard, and was to the inspiratory nearly as 3 to 10.—Eight leeches were applied to the temples.

At 4 P.M. he had a copious watery stool, one pint in quantity, without cramps or pains.

At 5 P.M., the report says, that there was no essential alteration ; he had been quiet and drowsy for the

previous hour. The extremities were cold ; the head and trunk cool ; cold, but not clammy perspirations continued ; the pulse could be felt at the wrist very small and thready ; the face, it was remarked, was not so collapsed and choleraic as it had been eight hours previously. The respirations were 32 per minute ; he said he felt easy, but was still restless.

I need not continue the reports during the night ; they are nearly in the same words. Towards morning the pulse increased in volume, and the skin became again warm ; he began to pass dark fluid motions. At 11 A.M. July 25, he voided for the first time 3vij. of perfectly transparent yellow urine.

From this time he passed into the stage of consecutive fever ; he passed his urine easily ; the stools were dark, and greyish in colour ; he suffered much from hiccup. The disease seemed to merge into an anomalous low or typhoid fever, with a sharp pulse, a dry burning skin, injected eyes, and a dry brown tongue : a blister which was applied to the epigastrium for two hours only, produced vesication.

I need not continue the reports, particularly as many of the symptoms were not sequelæ to Cholera, but were produced by treatment. He died on the 28th July, having been four days in hospital.

I have already given the post-mortem examination, in the chapter on Consecutive Fever.

This case gave me great hopes of future success. At one time I had no doubt of this man's recovery. When the operation was performed I thought he had

about six hours to live, and as I never saw so severe a case run on to consecutive fever, I conclude that the injection did really prolong life, and cured the algide symptoms of the disease.

OBSERVATION III.

An English soldier, æt. 26 ; height 5 ft. 8 in.; taken ill suddenly at 10 P.M. July 27th : admitted into hospital at 3 A.M. July 28th, deeply collapsed.

At 5 A.M. the case was hopeless ; the vomiting and cramps had ceased ; the skin was icy cold ; the tongue cold ; the pulse imperceptible at the wrist ; the face sunken ; the eyes hollow ; the breathing laborious ; the voice a whisper.

At 6 A.M. he had a watery-stool, Oiss. in quantity ; no cramps ; the algide symptoms were advancing.

At 17 minutes to 7, six pints of the alkaline solution of albumen were injected into the veins : the operation lasted 18 minutes. The pulse immediately became perceptible ; the skin became warm, and lost the icy clammy feel ; the tongue continued cold.

At 7 he had a watery-stool, 3vij. in quantity, and there were violent attempts at vomiting.

At 15 minutes past 7 he had two more stools of 3x. and 3iv. respectively ; there were no cramps ; the skin was again cool, and the pulse smaller.

At 12 minutes to 8, five pints more of the alkaline solution of albumen were injected into the veins ; the pulse again rose, the face became flushed, and the skin

warmer. He said he felt exceedingly cold, and there was a very slight rigor.

At 5 minutes past 8 the pulse was beating strongly at the wrist.

At half-past 8 he began again to sink ; the pulse became impereetible, and the skin cold : the mind continued quite clear.

He died at half-past nine.

Sectio Cadaveris, one hour and a half after death.

On opening the thorax the lungs were found to be exceedingly collapsed from the ribs and sternum, being diminished to less than half their volume.

Right lung.—Weight, 3xivss.; left lung—weight, 3xiiss.

Very little blood exuded from the roots ; both lungs were devoid of air, and had a resisting leathery feel ; they floated in water. On section, they exuded very little blood, and hardly any serum ; the section was pale, and became of a dark red colour by exposure to the air. The posterior parts of the lungs were not darker, and did not contain more blood, than the upper portion.

Heart.—Weight, 3xss.; pericardium healthy ; right ventricle flaccid ; walls two lines thick at the base. Left ventricle firmly contracted ; walls above an inch thick, and cavity very small ; valves and endocardium healthy. There was no blood in any of the cavities of the heart.

The abdominal veins were all distended with blood.

Some blood being collected from the inferior vena cava, began immediately to coagulate ; after 20 minutes the clot had become somewhat arterialized on the surface ; where the blood had ran down the side of the vessel it was arterialized completely.

The appearances in the other organs need not be detailed.

At the time of the operation, I presumed that this man had four or five hours to live : I therefore suppose that the operation accelerated death. I regretted afterwards that I had injected the second quantity, and that I had not given the case a little more time ; but I was prejudiced in favour of repeating the injection, by its good results in the previous case.

However, I was so far dissatisfied with the plan, that I returned to the old methods for the next few patients, until the unfavourable results of these cases made me resort again to the injection.

The next case, however, was not more favourable.

OBSERVATION IV.

An English soldier, æt. 24 ; height 5 ft. 6 in. Admitted 7th August, 7 A.M. This was one of those rapid and fatal cases with severe cramps but with little purging, and in which after death a large quantity of the clotted substance is always found in the eanal.

At half-past 9 the case was hopeless ; the patient was pulseless ; the skin was icy cold and livid ; the tongue cold and white ; the voice a whisper ; the lips livid ; the eyes sunken ; the skin was bathed in

profuse cold perspirations ; the cramps in the legs were constant, but were becoming much less severe.

At 20 minutes to 10, six pints of the albuminous solution were injected into the veins ; the operation was finished in 20 minutes. The pulse immediately became perceptible ; the voice became stronger ; the cramps ceased. Directly after the operation he vomited violently more than a pint of fluid. Ten mimins of Tinct. Opii being given, he had retching, but no vomiting.

A few minutes after the injection, the pulse could be counted at the wrist—108 ; the Cholera visage had nearly disappeared.

At half-past 10 the skin was cool, not icy cold or clammy ; there was no perspiration ; pulse at the wrist 98. Respirations 20 per minute, chiefly costal ; tongue still cold ; no cramps since, or during, the injection ; he complained of drowsiness ; there was no appearance of rigor ; the voice was husky, but not whispering.

Draughts of ammonia and ether were given.

At 11 o'clock he was apparently asleep ; the pulse was still perceptible ; the skin cool, but dry ; the breathing was tranquil. No stool or cramps since the injection.

At 12 o'clock he was still quiet, but the pulse at the wrist was almost gone ; the skin was cool and dry ; the lips livid again ; the face fallen in ; the scleroticae injected. He vomited a small quantity of fluid ; the intellect was clear.

At 1 o'clock he had become pulseless, deadly cold and livid ; no cramps, purging, or vomiting.

At 25 minutes to 2 P.M. he died.

Sectio Cadaveris, four hours after death.

Both lungs were collapsed from ribs and sternum. A good deal of blood escaped from the veins of the neck, about $\frac{3}{4}$ viiij. from the root of each lung. The blood from the lungs contained some small dark polypi ; beyond this the blood did not coagulate.

Right lung.—Weight, $\frac{3}{4}$ xiii. When removed, the lung was found pale on the surface and on section ; it was non-crepitant, and had an oleaginous leathery feel. On section very little blood exuded ; the cut surfaces were at first pale, but soon became dark ; there was no frothy serum in any part of the lung. The mucous membrane of the bronchial tubes was pale, and free from mucus.

Left lung.—Weight, $\frac{3}{4}$ xi. Like the right lung it exuded some blood on section of the root ; none on section of the structure : it was collapsed, non-crepitant, with an oily, leathery feel between the fingers ; its cut surfaces soon became very dark red in colour, and it then looked not unlike some of the forms of pneumonia. Bronchial mucous membrane pale.

Heart.—Some blood flowed out of the left ventricle as well as from the right ; the right ventricle was dilated, its walls about 2 or 3 lines in thickness ; the left ventricle was contracted ; its walls 1 inch in thickness. The valves were healthy. The weight of the heart was

accidentally omitted, but I presume its size was not remarkably altered. There was a large quantity of the elotted substance in the small intestines.

I could not eonjeeturc how long this man would have lived if the injection had not been practised. I am inclined to think, however, that he might have lived six or eight hours, or perhaps even twelve; I should not have been surprised, however, if he had died in four; so that I do not think it an easy matter to decide whether the injection shortened life.

I hardly expeeted the injeetion to do any good in this ease; the patient was virtually dead when it was employed.

I was, however, so far again disencouraged by this unfavourable result, that the next two eases were treated only with the aeetate of lead. As they were both fatal, however, I determined to give the injeetion another trial in the next ease.

OBSERVATION V.

An English soldier, æt. 26; height 5 feet $7\frac{1}{2}$ inches.

Admitted at half-past 1 P.M.—Six stools before admission; algide symptoms well marked. He was treated with calomel and opium for an hour and a half, and then acetate of lead was commeneed.

At half-past 3 the report mentions that there were severe eramps in arms and forearms, thighs, and legs; the lips and tongue were deadly cold and livid; the face deeply choleraie; the voice a whisper, except when

the cramps were present, and then he shouted ; when the cramps ceased from time to time he appeared sleepy ; skin of hands corugated—icy cold.

At twenty minutes past 4 the cramps were becoming feeble, and were chiefly confined to the hands and feet ; the pulse was imperceptible at the wrist ; the skin was icy cold, and clammy ; there was still great thirst.

At twenty minutes past 4 the skin began to get dry.

At ten minutes to 5 there was a return of the cramps in the legs and thighs.

At twenty minutes past 5 four pints of the alkaline solution of albumen were injected into the veins. Immediately before the operation, the patient was deadly cold and pulseless, with constant cramps in the legs. During the operation, which lasted thirteen minutes, the cramps ceased, and he went to sleep. When three pints, or three pints and a half, had been injected, he suddenly awoke, and vomited violently, first some clear fluid, then some fluid deeply tinged with blood : the pulse became perceptible during the operation : after it was over it became of tolerable volume—100 ; the skin lost the cold icy feel ; the cramps did not return ; the man said he felt easy ; he appeared very drowsy, and shortly after the operation the skin became gradually darker in colour, though the face was not so much fallen in as before. He continued the acetate of lead.

At 6 he went to sleep, but was roused up to take his pills every half hour, and was quite sensible.

At twenty minutes to 8 the breathing had become hurried and laborious ; the skin was becoming cold, and

cold sweats were again breaking out ; the pulse was very small and thready.

At 8 he was sinking in the usual way, and he died at seven minutes to 9.

The operation did not probably either accelerate or retard death ; but it certainly appeared to remove the cramps, as in the former case.

Sectio Cadaveris, fourteen hours after death.

Right lung, weight.....	3xv.
Left ,, ,, 	3xiiiss.

Chest.—Universal old adhesions of both lungs, completely preventing collapse. On cutting out the lungs very little blood issued from the roots ; each lung had a darkish colour externally, and a pale section, which became red on exposure ; they were non-crepitant, and had an oily, leathery feel ; in some parts there was a small quantity of frothy and bloody serum ; in other parts there was no serum—in fact, a great part of each lung was perfectly pale, and contained no blood or serum. In one or two places, particularly in the dependent portions, there appeared to be a little extravasation of blood. In the apex of the right lung was a small cluster of hard, grey, tubercles. In the apex of the left lung there were two or three detached and solitary tubercles, hard, round, and of a greyish white colour. Both lungs floated in water. The mucous membrane of the bronchial tubes was of a

very dark-red colour, and the tubes contained some thick whitish mucus : the longitudinal fibres were perhaps unusually distinct.

Heart.—Weight, 3x.

About 3*i.* of reddish serum in pericardium, becoming solid by heat. All the cavities were flaccid, but the right more than the left. Several ounces of liquid blood escaped from the pulmonary artery and the aorta. There was a large polypus in the right ventricle. In the left ventricle there was a smaller polypus ; the rest of the blood did not coagulate, but deposited on standing a loose cloud of colouring matter, partly suspended in a red supernatant fluid. Slight congestion of posterior coronary vein. Valves and endocardium stained, but healthy.

After the heart was removed, there flowed into the cavity of the thorax from the inferior vena cava, and to a smaller extent from the aorta, about Oiss. of fluid blood, containing a few grumous clots. Colouring matter commenced to be at once deposited. There was a large quantity of the white clotted substance in the intestinal canal.

The other organs presented the usual appearances.

I did not after this use the injection again, but returned to some remedies I had used before, and as the epidemic soon after this became much milder, and then ceased altogether, I had not another opportunity of using the albuminous solution.

My own impression is still somewhat in favour of this practice. All these five cases were of the worst kind ; there did not appear to be a chance of recovery

for any of them under the ordinary treatment, and yet one was certainly carried through the cold stage, and, if differently treated during the consecutive fever, might have been completely cured. I think also that the alkaline solution might have been made weaker with advantage, and other ingredients might perhaps have been added.

The severe rigors, exactly resembling the cold stage of ague, which occurred in the two first cases, were symptoms not noticed, I believe, in Dr. Mackintosh's cases. The subject of the first case had suffered from remittent fever, and irregular intermittent, for some months, about a year before his death ; the second case had suffered from severe ague several times in Jamaica about eight or nine years previously. The other three patients had not suffered from malarious fevers. I do not wish to connect the occurrence of these rigors with any susceptibility given by previous attacks of ague ; I only mention it as a curious coincidence. The revivifying effects of the albuminous solution seemed to be as well marked as any recorded of the saline injections by themselves ; the return of animal heat was, indeed, very manifest in some of the cases. The operation should, I think, be again tried ; it is very simple ; it gives no pain, for in this stage of Cholera the skin is almost insensible ; and it can do no harm to the patients, who are, in fact, doomed to almost certain death. The possible supervention of phlebitis in an after stage should, I think, be disregarded ; this disease is less formidable than Cholera. The object of the injection is not to cure Cholera, but to restore and

to sustain the circulation for some few hours, until the healing force of nature may repair the lesions of the blood and restore to the vitiated fluid its normal composition.

I need not occupy space by detailing the treatment of the premonitory stage of Cholera; this will be at once understood. The arrest of the watry purging almost invariably stops the disease. I have never witnessed any ill effects from this method, but I have once or twice had deep reason to regret that I neglected it.

In the consecutive fever, leeches to the head, chest, and epigastrium, should be freely applied. Alterative doses of calomel, ippecacuanha, and colocynth, are exceedingly useful. Evacuants to clear out the canal, and low diet for a few days, are absolutely essential. The hiccup is often a most distressing symptom, and is not easily cured. Opiates are not, I think, of the slightest use. Bismuth, cajeput, belladonna, and stramonium, are sometimes useful. The cause of this hiccup is not very evident; sometimes there is no gastritis with it, and no irritability of the stomach, and it appears more like a spasmodic contraction of the diaphragm connected with the state of the lungs. If so, the inefficacy of measures directed to the stomach is easily understood.

Although the treatment of the severest forms of Cholera has not hitherto been successful, yet, considering the virulent nature of the active cause, I think there is reason for congratulation that the medical art can do so much. It can arrest the disease in its premonitory stage; it can

with tolerable certainty carry the patient through the consecutive febrile affections. It can successfully treat the milder cases seen towards the end of an epidemic. If at present the deep algide stage is beyond its control, there is no reason to dread that such will be always the case. I firmly believe that some great discovery will speedily reward the efforts of the pathologist, and that a more certain knowledge of the morbid changes in the blood will indicate to us the antidote to this poison, at present so terrible and resistless.

APPENDIX.

SKETCH OF THE TENASSERIM PROVINCES.

THE Tenasserim provinces* are that portion of Burmah ceded to the Company in 1826, by the treaty of Yandaboo. They form a narrow strip of territory, extending from lat. 10° to $17^{\circ} 30''$ N., and from long. 97° to $99^{\circ} 30''$ E. They are bounded on the north by Burmah Proper and the Shan States, on the west by the Bay of Bengal, and on the east and south by Siam and the country of the Malays. They have an area of about 30,000 square miles, and a computed population of 150,000 souls.

The circumstances which give its characters to the country are shortly these:—its geographical position near the Equator; its physical conformation, viz. of ranges of hills and intermediate plains; and the unusual length of the wet season.

Throughout the whole extent of the provinces there is a constant succession or alternation of bold ranges of hills, chiefly pursuing a north and south direction, with vast plains between. The larger hills are com-

* The first epidemic of Cholera was observed in these provinces. The other epidemic was witnessed in Madras. The medical topography of Madras is so well known, that I need not occupy space by discussing it in this place.

posed of granite, quartz, and gneiss; the smaller ones of limestone and sandstone.

The year is divided into the wet and dry seasons; the rainy season begins in May; the south-west monsoon blowing over the Indian Ocean and the Bay of Bengal, begins to prevail towards the end of May, and lasts till the beginning of October. During this time from 120 to 200 inches of rain fall. From October to March the north-east monsoon prevails, and no rain falls. From March to May there is little wind and no rain, and this is the hottest time of the year.

From these facts the general features of the provinces might easily be deduced. We might have anticipated various outlets for the immense quantity of water that falls, and accordingly we find several large rivers, collecting innumerable tributary streams, passing down from the high lands, and emptying themselves into the Bay of Bengal. These rivers, loaded with debris, overflow their banks during the wet season, and flood the adjoining plains. All the plains are thus covered with the richest alluvial soil for many feet. With this soil, and with this great fall of rain, as might be anticipated, the whole country is covered with exuberant vegetation. Immense forests cover the hills and plains, or these latter are occupied by clumps of gigantic bamboos, long coarse elephant grass, and dense jungle brushwood. The rapidity of growth with which vegetation springs up on this rank soil, beneath the burning rays of the tropical sun, is really surprising. The present labour of the population of the largest town cannot keep the ground clear even in its immediate

vicinity, and places cleared by fire are again covered by jungle in the course of a very few months. A deserted village is overflowed by the forest like the waves of the sea, in the course of two wet seasons, and the traces of man are buried by the exuberant productions of nature.

When the English landed in Tenasserim, two or three miserable villages, cleared in the midst of the wildest jungle, were all the remains of this once rich and populous portion of Pegu. Long wars, and an oppressive rule, had almost annihilated the inhabitants, and in the antique forests of Eastern Asia the desolation was as complete, as in the untraversed and unpocpled tracks of the new world.

Even now, although a large city has arisen on the banks of the Salween, the largest river in the provinces, though the advantages of British commerce are attracting even the inert and sluggish Burman, still the forests are almost untouched; thick jungle, giving shelter to herds of wild elephants, to the rhinoceros, and the tiger, still covers the ground, and comes up to the very limits of the military stations.

The principal town of these provinces, Moulmein, is situated on the eastern bank of the river Salween, in lat. $16^{\circ} 30' N.$, and about thirty miles from the sea. The Salween at this point is a stream about three miles broad, with low muddy banks, covered with jungle to the water's edge. The houses of the Burmans run for four miles close to its bank, and many of them elevated on stakes are placed within the high-water mark, so that at high tides the water washes under them.

About half a mile from the river is a low range of

limestone and red sandstone hills ; between this range and the river stands the eantonment, on a gradual slope, whieh carries off the superabundant water. To the east of the low hilly range, in rear of the cantonment, is an immense plain, stretching for about forty miles, interseeted by two or three rivers, and with its surface diversified here and there by detached masses of limestone rock, whieh, covered with trees to the summit, rise isolated and abruptly to the height of from four to eight hundred feet. This plain is partly covered with jungle, partly clear, and partly cultivated with paddy. It is flooded for three or four months annually, and gradually dries after the cessation of the rains in Oetober. In Oetober, November, and Deeember, while it is slowly drying, its rich, adhesive, alluvial soil becomes eleft and split into deep fissures, by the burning rays of the sun ; and the north-east monsoon blows direetly over it upon part of the Burmese town, and upon the eantonment, whieh is, however, protected in some degree by the low hilly range forming its rear. At the further extremity of the plain rises a range of mountains pursuing a north-easterly direction, and beyond this are other plains again bounded by hills, and so on throughout the whole extent of the provinces.

On account of the great quantity of rain, the houses of both Europeans and natives are generally elevated on stakes to the height of from one to ten feet. Several of the soldiers' barraek-rooms are, however, built almost upon the ground.

The climate of Moulmein is peculiar, on aeeount of the great length of the wet season, and in this charac-

ter, and in the nature of the diseases induced, there is a great resemblance between the Tenasserim Provinces, Arracan, and some places on the Malabar coast, particularly Cannanore.

As there is no winter, or rather as perpetual summer prevails, the seasons are divided into the dry and the rainy. The dry season is divided again into the cold and the hot.

The Burman year commences with the first full moon in October, when the rains are considered to be at an end.

During October, the low grounds are gradually drying; the temperature is considerable; the thermometer stands at 86° or 89° Fah. at 2 P.M., and at 76° or 75° at day-break; it has a daily range of 10° or 12° . The winds are variable, chiefly from the north and east, and are dry and sometimes hot.

In November the low grounds are still drying; the daily range of the thermometer increases; it stands at 72° or 70° at daybreak, and reaches 86° or 88° at mid-day. The nights are cool and fine; the winds northerly and easterly, and regular. Remittent fevers, chiefly of the malignant and adynamic type, prevail among the Burmese, but not to any great extent.

In December the plains get quite dry; the nights are cool, and the thermometer sinks to 63° or 65° at day-break, and rises to 82° or 84° at mid-day. The north-east wind blows in the morning; in the evening there is a cool sea breeze. The nights are clear, and dew is therefore largely deposited, from the great radiation which takes place from the ground to the unclouded

sky: in addition to this, towards day-break, the dry north-east wind begins to blow, and meeting with the south winds charged with watery vapour, by travelling over the sea, causes to be deposited a complete mist of vapour, which hangs on the ground from day-break till the sun acquires sufficient power to disperse it.

Malignant remittent fever occurs at this time among the Burmese, and certain forms of irregular marsh fevers. Among the Hindoo convicts in the jail, agues are common.

In January the thermometer has a daily range of from 12° to 18° , rising from 60° or 64° at day-break to 82° or 84° at mid-day. There are also the daily north-east winds, the cool evening breeze, and the morning fogs. The nights are very cool, and beautifully clear.

In February the weather begins to get warmer; the thermometer rises from 66° or 70° at day-break, to 86° or 88° at mid-day. The morning mists are lessened, and the north-east winds become irregular.

These three months are for Europeans the healthiest in the year. In December there is occasionally some dysentery, but this is usually trifling.

In March the weather becomes very warm, and in the middle of the month commences the hot season of the Burmans. The thermometer rises from 72° at day-break, to 90° or 92° at mid-day. The sea breeze blows in the evening, and the nights are cool, but the days are intensely hot. The daily range of the thermometer is now 20° to 24° . This is a healthy month.

In April the hot season has fairly set in; the ther-

mometer ranges from 72° to 96° or 98° , having a daily range of 26° or 30° . The days are extremely hot, but the nights are tolerably cool. The sea breeze prevails in the evening. From the great daily range of the thermometer, ephemeral fevers often prevail, and catarrhs are very common, and among the Burmans, rheumatism is seen, generally of the subacute or chronic migratory form.

In May the heat still continues ; the thermometer stands at 76° in the morning, and rises to 98° or 100° at mid-day. In the coolest houses it reaches 93° or 95° . In the badly built houses, and in the soldiers' barracks, it often reaches 100° or 102° . The rains begin some time from the 10th to the 20th ; occasionally they are later than this, not beginning till the 25th.

During the whole dry season, the barometer stands usually between $29^{\circ}.9$ and $30^{\circ}.2$. The daily range of the thermometer is on an average 25° for the hot months. At the latter end of May, the sea-breeze begins to prevail with greater regularity ; and morning and evening, dark lowering clouds surround the horizon, accompanied with lightning and low rolling thunder ; towards the end of the month heavy showers occur, causing a sudden sinking of the thermometer 10° or 12° . Between the intervals of the showers the sun is very powerful, and these sudden and violent alternations induce as in the previous months ephemeral fevers and febricula. Bilious remittent fevers now begin to appear, but are not so common as in the following months. The average quantity of rain during May is from 12 to 25 inches.

In June the rains regularly set in ; the thermometer has a daily range of not more than 5° , standing at 78° in the morning, and reaching 80° or 83° at mid-day. Sometimes there are breaks in the rain, and then three or four days of very sultry weather ensue, though the barometer does not indicate this heat, (which is perceived by the senses), or if raised a few degrees it is again suddenly lowered by the next shower. During this month sickness begins to prevail among the troops. Simple and bilious remittent fevers are seen, and ague. Dysentery begins to appear, and is often combined with ague or remittent fever.

From 30 to 50 inches of rain fell during this month.

In July there are many days of incessant rain with breaks of fine warm weather ; the thermometer averages the same as in June. The quantity of watery vapour in the atmosphere is astonishing ; woollen clothes feel damp while on the person ; leather is thickly mildewed in 24 hours ; meat taints with the greatest rapidity, and it is impossible without the greatest care to preserve dried plants or zootomical preparations.

Dysentery is now common ; bilious remittent fever continues to prevail, though it is less frequent. Agues, or more commonly regular attacks of fever, still exist among the Burmese. Purpura and scorbutic symptoms are common.

From 45 to 60 inches of rain fall this month.

In August the fine days are becoming more numerous ; still there are many days of very heavy rain. The thermometer has the same range as in June and July. Dysenteries and remittent fevers are still com-

mon. The average quantity of rain is from 35 to 45 inches.

In September the weather gets hotter ; the thermometer rises from 76° to 84° ; from 20 to 30 inches of rain fall. In this month begin the cases of malignant remittent fever, but the cases of bilious remittent are less numerous in this and the following months,—at least this holds good among the Europeans. Bronchitis, pneumonia, and febricula, are seen among Europeans, on account of the great differences of temperature : two or three days are fine and hot, and the thermometer is then suddenly lowered by another deluge of rain. This is, however, a healthier month than the three preceding.

During the wet season the thermometer ranges from $29^{\circ} 5'$ to $29^{\circ} 95'$.

At first sight such a country as I have described would be considered very unhealthy, for the conditions supposed to be necessary for the development of malaria exist in great abundance. But on the contrary, it is for European constitutions a very healthy climate, and there is no great amount of remittent fever, unless there has been actual exposure in the jungle. To prove this, I went over the records in the Staff-Surgeons' Office with great care for a series of years. Judging from these returns, dysentery was the most prevalent disease ; the greatest number of cases admitted in any one month was 90, out of a garrison of 1100 men. The admissions of dysentery per annum were 182, out of an European garrison of 1000, on an average of four years. In addition,

during these four years there were about an equal number of cases returned under the head of diarrhoea. Hepatitis was tolerably frequent ; the greatest number of cases in any one month was 14, out of a garrison of 950. The returns for this disease are, however, not to be depended on for several reasons. One year, common ague was frequent—17 cases being admitted in one month, 13 in the next ; during the following year only 7 cases are returned during the whole year, but the number of remittent fevers was much greater, and this year the admissions from dysentery reached their highest number, being 302 for the whole period. These returns are taken from years subsequent to those employed in the Army Medical Report.

THE END.



